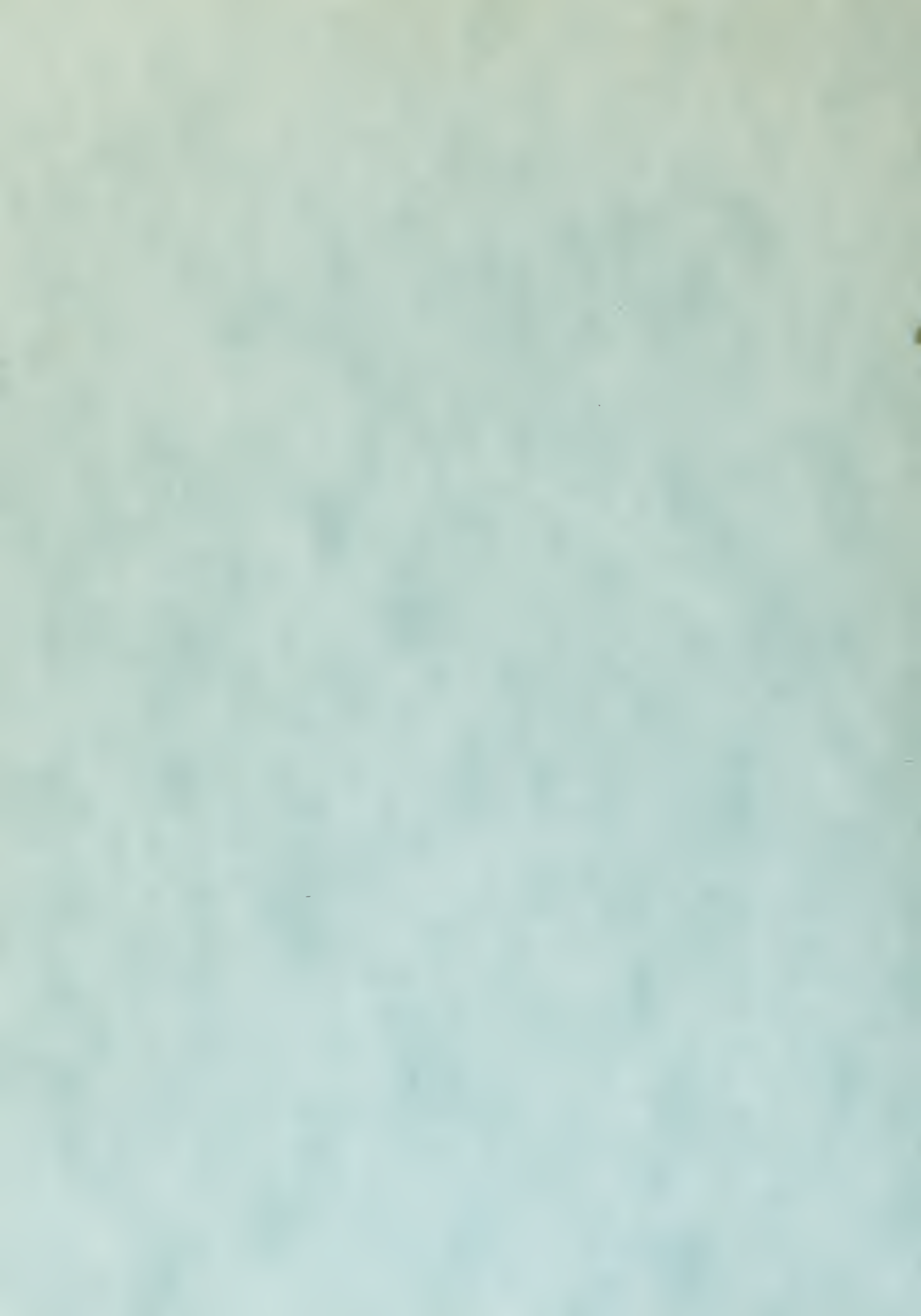


THE EFFECT OF ROLL AND PITCH ON
ANTENNA RADIATION PATTERNS

Stanley Robert Szemborski



NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

THE EFFECT OF ROLL AND PITCH ON
ANTENNA RADIATION PATTERNS

by

Stanley Robert Szemborski

Thesis Advisor:

J. B. Knorr

September 1972

Approved for public release; distribution unlimited.

T152288

LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIF. 93940

The Effect of Roll and Pitch
on
Antenna Radiation Patterns

by

Stanley Robert Szemborski
Ensign, United States Navy
B.S.E.E., United States Naval Academy, 1971

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

from the
NAVAL POSTGRADUATE SCHOOL
September 1972

ABSTRACT

The strength of an incoming signal to a shipboard communications station is measured. The variations in this signal are analyzed for various conditions of roll, pitch, and signal direction. Graphs and computer outputs are used to present the magnitude and randomness of these signal variations. A smooth surface approximation is used to simulate the problem, and this simulation is compared to observed data.

TABLE OF CONTENTS

I.	INTRODUCTION -----	5
II.	THEORY OF THE PROBLEM -----	6
	A. SIMPLE ANTENNA OVER GROUND -----	6
	B. ROTATION OF THE ANTENNA -----	7
	C. EFFECTS OF A ROUGH GROUND PLANE -----	7
	D. THE SEA AS A GROUND PLANE -----	9
	E. THE COMPOSITE PICTURE -----	9
III.	EXPERIMENTAL PROCEDURE -----	11
	A. EQUIPMENT SET UP -----	11
	1. Antenna Properties -----	11
	2. Research Vessel Acania -----	13
	3. Recorder and Receiver -----	13
	B. ANALYSIS OF DATA -----	15
	1. Form of Output Data -----	15
	2. Interpreting the Data -----	15
	3. Computer Program Distribution -----	17
	4. Computer Program Variation -----	17
	C. SIMULATION OF PROBLEM -----	20
	1. Program Set Up -----	20
	2. Use of Program in this Problem -----	24
IV.	EXPERIMENTAL RESULTS -----	25
	A. STRIP RECORDER PLOT -----	25
	B. DISTRIBUTIONAL ANALYSIS -----	25
	C. VARIATIONAL ANALYSIS -----	30

D. SIMULATION ANALYSIS -----	31
E. SHORTCOMINGS OF ANALYSIS -----	32
V. CONCLUSIONS -----	33
APPENDIX A: COMPUTER OUTPUT -----	34
APPENDIX B: COMPUTER PROGRAM -----	168
LIST OF REFERENCES -----	188
INITIAL DISTRIBUTION LIST -----	189
DD FORM 1473 -----	190

I. INTRODUCTION

The radiation pattern of a shipboard antenna is complicated by the fact that the sea is not a smooth ground plane. In reality the sea is a rough surface which will scatter an incoming wavefront. In addition to this problem, the antenna is not a fixed object in space; it moves in both position and orientation as the ship rolls and pitches. The ship itself is another complicating factor. Even though the ship is electrically insulated from the antenna, interaction occurs, just as there is interaction among reflectors, directors, and the active elements of a yagi antenna. As a result, the shipboard antenna pattern is too complex to be predicted accurately even with the advanced matrix methods of computer solution which have been recently developed. The mathematical formulation of this problem is feasible, but the number of required calculations is prohibitive.

The number of complicating factors makes approximations necessary. Ultimately then, all attempts to solve the problem of shipboard antenna systems are limited by the approximations made. Even if all approximations are valid, any deterministic solution is doomed to failure due to the randomness of the sea. Some type of probabilistic model is necessary to predict system behavior.

II. THEORY OF THE PROBLEM

A. SIMPLE ANTENNA OVERGROUND

The problem of the vertical stub antenna of length "L" and height "H" above a plane horizontal ground of infinite conductivity can be easily solved by the method of images.¹ The electric field intensity of this system may be defined as a function of elevation angle " α " and distance "r".

$$E(\alpha, r) = \frac{60}{r} \sqrt{\frac{W}{R_{11} + R_{1L}}} \frac{\cos(\ell(2\pi/\lambda) \sin \alpha) - \cos(\ell(2\pi/\lambda))}{\cos \alpha}$$

where R_{11} = self-resistance of a vertical stub antenna of length ℓ referred to the point of current maximum

R_{1L} = effective loss resistance of antenna referred to same point

W = power input

In a shipboard VHF communications system the antenna is often located several wavelengths above the sea. When a vertical stub is positioned several wavelengths above the perfect ground plane, the horizontal field pattern remains circular or isotropic, but as the antenna is elevated the vertical pattern will include more and more null and maximum points. That is, as the antenna is elevated the vertical pattern will contain more lobes. This increased number of lobes can significantly change received signal strength. A

¹Kraus, John D., Antennas, p. 314, McGraw-Hill, 1950.

small change in the elevation angle of the incoming signal can cause a large change in received signal strength. This same effect can be expected to occur in shipboard systems.

B. ROTATION OF THE ANTENNA

If the stub antenna over perfect ground is tilted in any direction the field strength pattern will change. This effect can be explained using the pattern multiplication method of analysis. According to this method an antenna array consisting of identical elements is considered to be an arrangement of point sources. The final pattern is the point source pattern multiplied by the element factor. In the case of the tilted stub over ground, the distance between the real and the image point sources will remain the same, but the rotation of the dipole pattern will change the overall field pattern. Thus as a ship rolls and pitches, and therefore the antenna is tilted, two effects take place. One effect is the change in the overall antenna pattern, and the other is the change in the point of entry of the electromagnetic waves on the antenna pattern. These two effects cause large but predictable variations in signal strength. Inherent in this discussion however, is the smooth surface approximation. The random wave patterns of the sea have not been included.

C. EFFECTS OF A ROUGH GROUND PLANE

Reflection of electromagnetic waves from a smooth surface as used in the previous discussion is a well understood

phenomena. In fact, the laws of reflection from a smooth surface are so well known that they are used to determine electrical properties of materials. If the surface is rough however, the electromagnetic energy will be scattered in various directions. To predict the form of the scattered field is a very difficult problem. This phenomenon has received particular attention in connection with radio propagation in the VHF range. In line-of-sight communication systems the field at the receiving point may be broken up into a direct and a reflected ray. In the case of a smooth earth the field pattern may be easily predicted as in the previous discussion of the tilted stub. When the surface is rough the problem rapidly expands. Since the surface of the sea is time varying, an exact solution is not possible. The received signal will be subject to fades which are determined by the form and movement of the sea. In analyzing random rough surfaces the surface is normally assumed to be isotropically rough. That is, the surface is assumed to have the same statistical distribution in all directions over the surface. When the surface distribution is different in the X and Y directions, the calculation becomes very involved. This case of anisotropic roughness occurs for the surface of the sea which may have a different distribution on and across the direction of the wind.²

²Beckman, P., and Spizzichino, A., The Scattering of Electromagnetic Waves from Rough Surfaces, p. 405, MacMillan, 1963.

D. THE SEA AS A GROUND PLANE

The surface of the sea has been the subject of many theoretical and experimental investigations. Schooley [1954] and Cox and Munk [1954] have measured the distribution of the slopes of the surface of the sea by optical methods. According to Cox and Munk this distribution is to a first approximation a normal type distribution. The standard deviation of this distribution is a function of the wind-speed. Their investigation also indicates that the slopes of the waves were higher in the upwind direction. This means that the sea is not isotropic. The distribution of wave slopes derived from measurement of back-scatter of radar pulses and by optical methods are in agreement. In both cases the distribution is normal.³ Information obtained to date indicates that to a second approximation the wave slopes are slightly asymmetrical and they depend upon the direction of the wind. Thus although the mechanism by which the sea scatters an electromagnetic wave is known, the sea surface is not known well enough to predict at any instant what the signal strength will be.

E. THE COMPOSITE PICTURE

Major signal strength variations will occur as indicated previously due to the roll and pitch of the antenna. In addition to these variations there is a randomness in the

³Ibid., p. 409.

variations due to scatter from the sea. As the ship rolls to one side the signal strength will not always move to the value predicted by the smooth surface approximation, it will be offset by some value determined by the sea reflections at that instant. Thus signal strength will vary to a band of values. The mean of this band should be determined by the degree of roll and pitch, and the variance of the band should depend upon wind conditions.

III. EXPERIMENTAL PROCEDURE

A. EQUIPMENT SET UP

1. Antenna Properties

In order to reduce the number of variable factors included in the collection of data the antenna used was nearly isotropic in the horizontal plane. If a non-isotropic antenna had been used all data would also have been dependent upon the antenna pattern in the direction of the source. In the vertical plane the antenna pattern had many lobes since the problem required that it be many wavelengths above ground. A quarter wavelength vertical element over a ground plane was chosen for its simplicity and its ability to meet problem requirements. The ground plane consisted of four aluminum radial elements. The antenna was designed using published curves.⁴ The elements were trimmed and the radials bent to tune the antenna to match a 50 ohm transmission line at 149.13 MHz. The final design consisted of an active vertical element 47.65 cm long. The ground plane consisted of four radial elements 47.7 cm long. The radials were bent down 45° from the horizontal. The measured horizontal pattern of the antenna under ideal conditions is shown in Figure 1.

⁴Jasik, H., Antenna Engineering Handbook, p. 14, McGraw Hill, 1961.

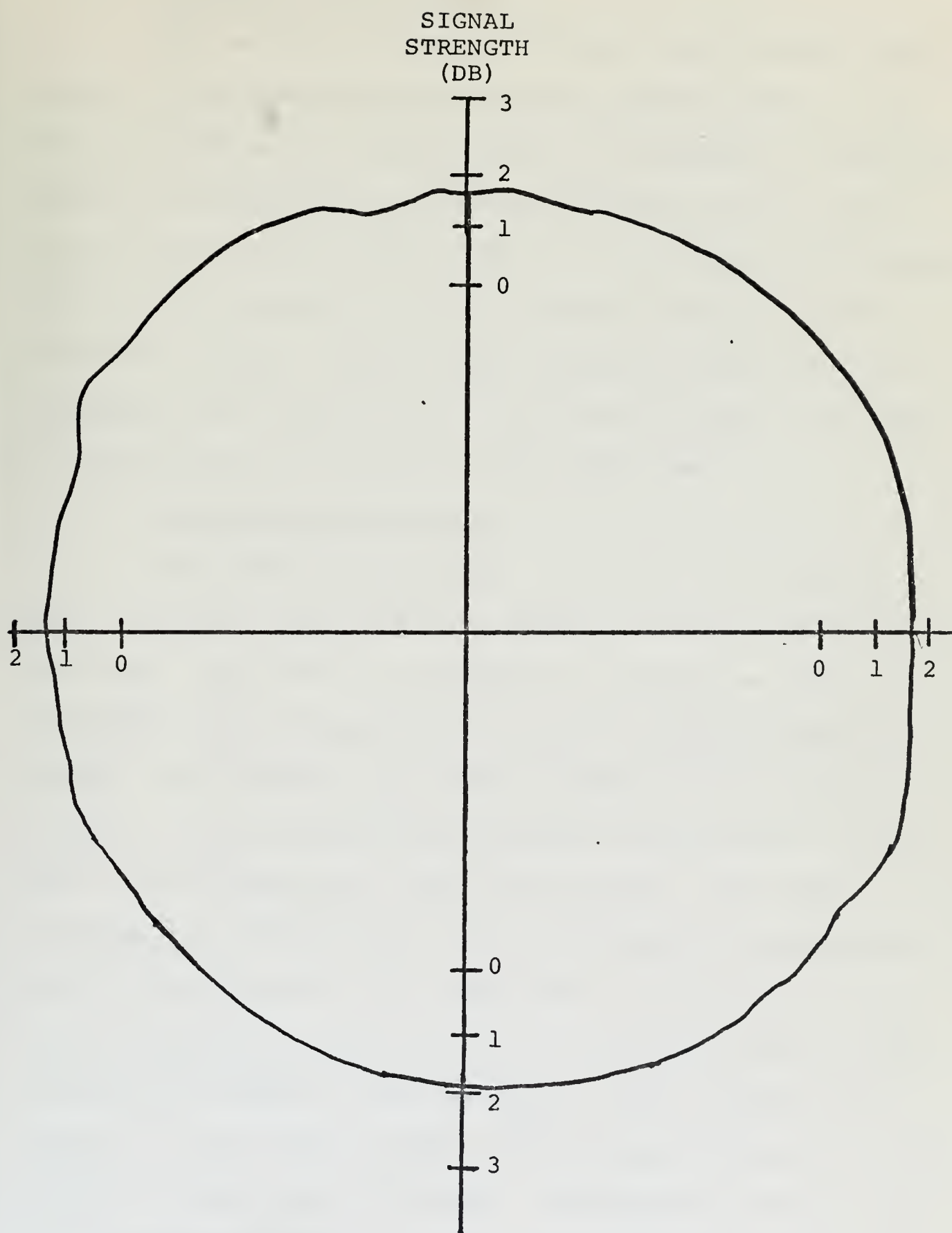


Figure 1. Measured Horizontal Antenna Pattern.

2. Research Vessel Acania

The antenna was mounted aboard the research vessel Acania. The mounting point was the highest point on the ship, 60 feet above the waterline. The Acania is operated under the sponsorship of the Oceanographer of the Navy by a five man civilian crew employed by the Naval Postgraduate School. The vessel is 126 feet overall with a beam of 21 feet 4 inches. Under normal operating conditions it displaces 246.8 gross tons. The Acania's small size made it an excellent platform for this experiment.

3. Recorder and Receiver

The receiving equipment consisted of an AN/URR-27 radio receiver connected to a Hewlett Packard #680 strip recorder. The URR-27 is designed to receive an amplitude modulated voice transmission in the 105-190 MHz frequency range. The receiver was crystal tuned to 149.13 MHz to avoid the drift problems encountered in the manual tuning mode. The transmitted signal was CW only. The basic receiver was modified for this experiment by disconnecting the AVC bus from the "IF" amplifiers. The strip recorder was connected from the AVC bus to an external power supply which was grounded to the receiver. This resulted in an output on the strip recorder that was approximately linearly related to the input CW signal. Calibration curves used, with different equipment settings are included in Figure 2.

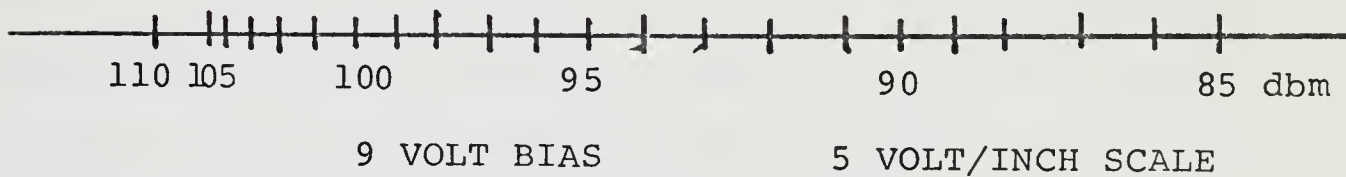
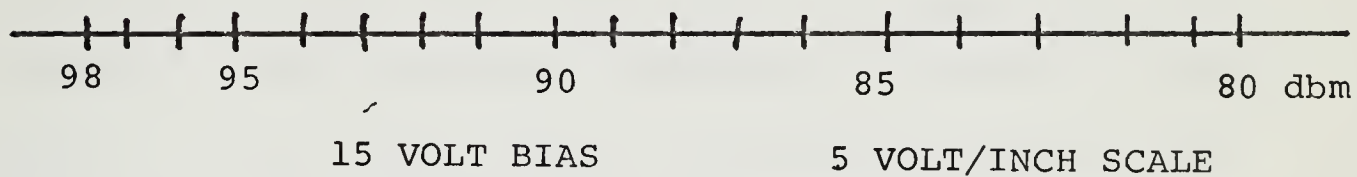
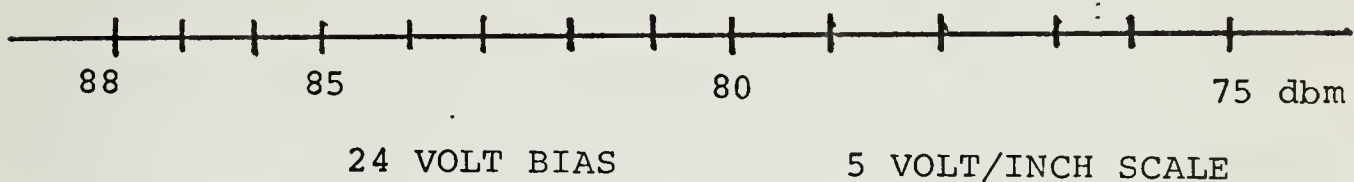
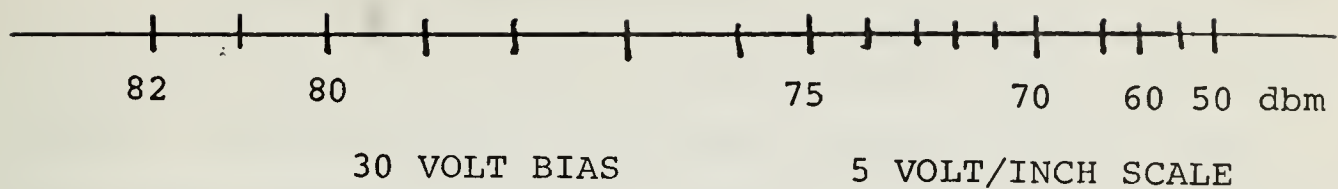


Figure 2. Calibration Curves for Strip Recorder.

B. ANALYSIS OF DATA

1. Form of Output Data

Received signal strength was continuously plotted on the strip recorder as the ship steamed from point to point. Along with the continuous signal strength plot, the ships course and speed, and the direction and distance of the radiating source were periodically recorded. Only a rough estimate of roll and pitch using the ship's inclinometer could be obtained. The average roll and pitch were the least accurate of data taken on each run. The numbers assigned to roll and pitch for a run were estimates of the average values for the run.

2. Interpreting the Data

Since the variations in signal strength were the primary consideration, only amplitude values were taken from the strip recording. Whenever the signal strength graph reversed direction and continued in the opposite direction for at least one half decibel, a signal peak was recorded. The value of one half decibel was chosen since equipment accuracy was limited to this value. All points were recorded with values of either a whole or a half decibel. Figure 3 shows how data was recorded. The numbers next to each peak are the recorded values. Circles indicate variations not recorded since the change was less than one half decibel. No time dependence is included in this procedure. The time between peaks varied from a fraction of a second to several seconds. After this step the

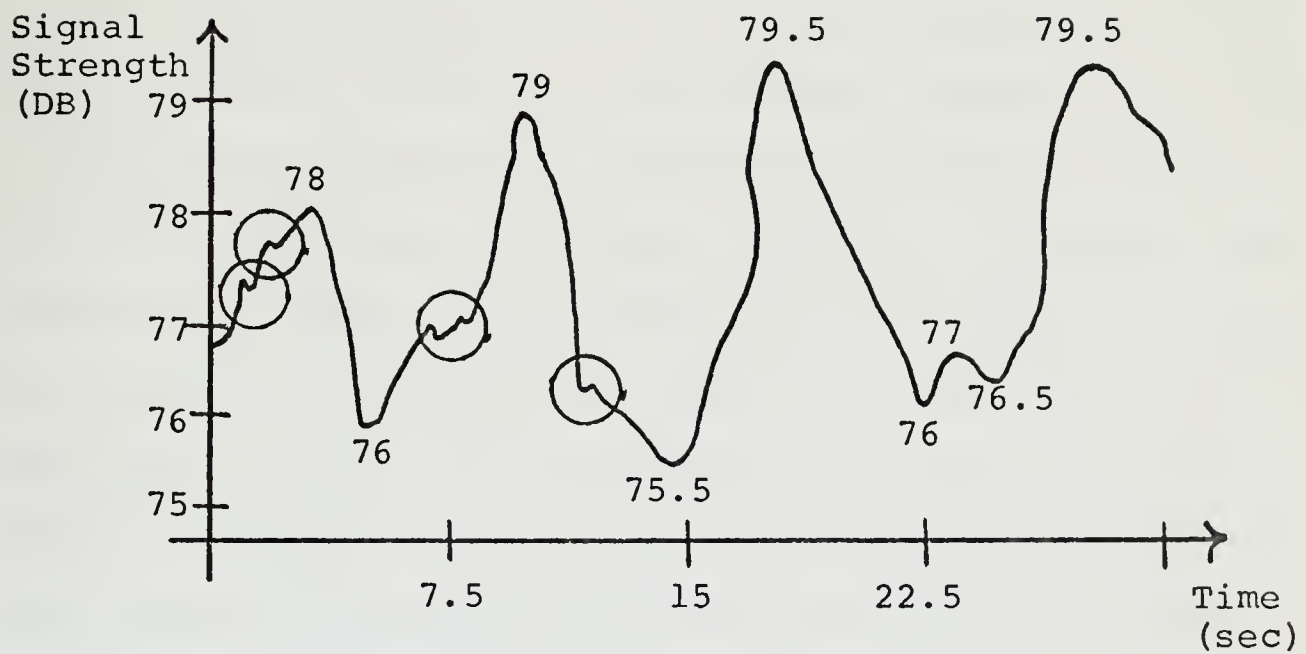


Figure 3. Digitizing the Strip Recorder Plot. Circles indicate variations less than one-half decibel. The numbers on the graph are the recorded values.

data consisted of a number of data points which represent signal strength peaks.

3. Computer Program Distribution

The first analysis of the data points was done by computer program "DISTRIBUTION." The output of this program is an un-normalized discrete probability density function of the signal strength peaks. Figure 4 displays the form of the computer output. Figure 5 is the graphical output. Data pertaining to the run being output appears at the top of the page followed by a listing of the data points taken from the strip chart. The next output is the average and standard deviation of the data points. The average value is subtracted from each data point and these values are quantized. These quantized values are counted and the number of values in each range is output. Since the average and standard deviation of the entire system has already been determined, the positive and negative portions of the graph are then analyzed separately. This allows a comparison of positive and negative swing tendencies. The graphical output of quantized values versus the number of points in that interval demonstrates how the signal peaks were distributed. This plot was used to determine the location of the signal peaks and the variability of the signal strength.

4. Computer Program Variation

The next analysis was done by computer program "VARIATIONS." Computer outputs are contained in

DISTRIBUTION RUN62 ROLL15 PITCH00
 COURSE 160 E&M DIR. 150 DIST 6.30

DATA POINTS

74.5	75.5	73.5	75.0	73.5	74.0	75.0	73.5	74.5
73.5	74.0	74.5	74.0	74.5	73.5	75.0	73.5	74.0
73.5	74.5	73.5	75.0	73.5	77.5	76.5	78.0	73.5
75.0	74.0	74.5	74.0					

AVERAGE POWER = 74.5DB STANDARD DEVIATION = 1.3

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

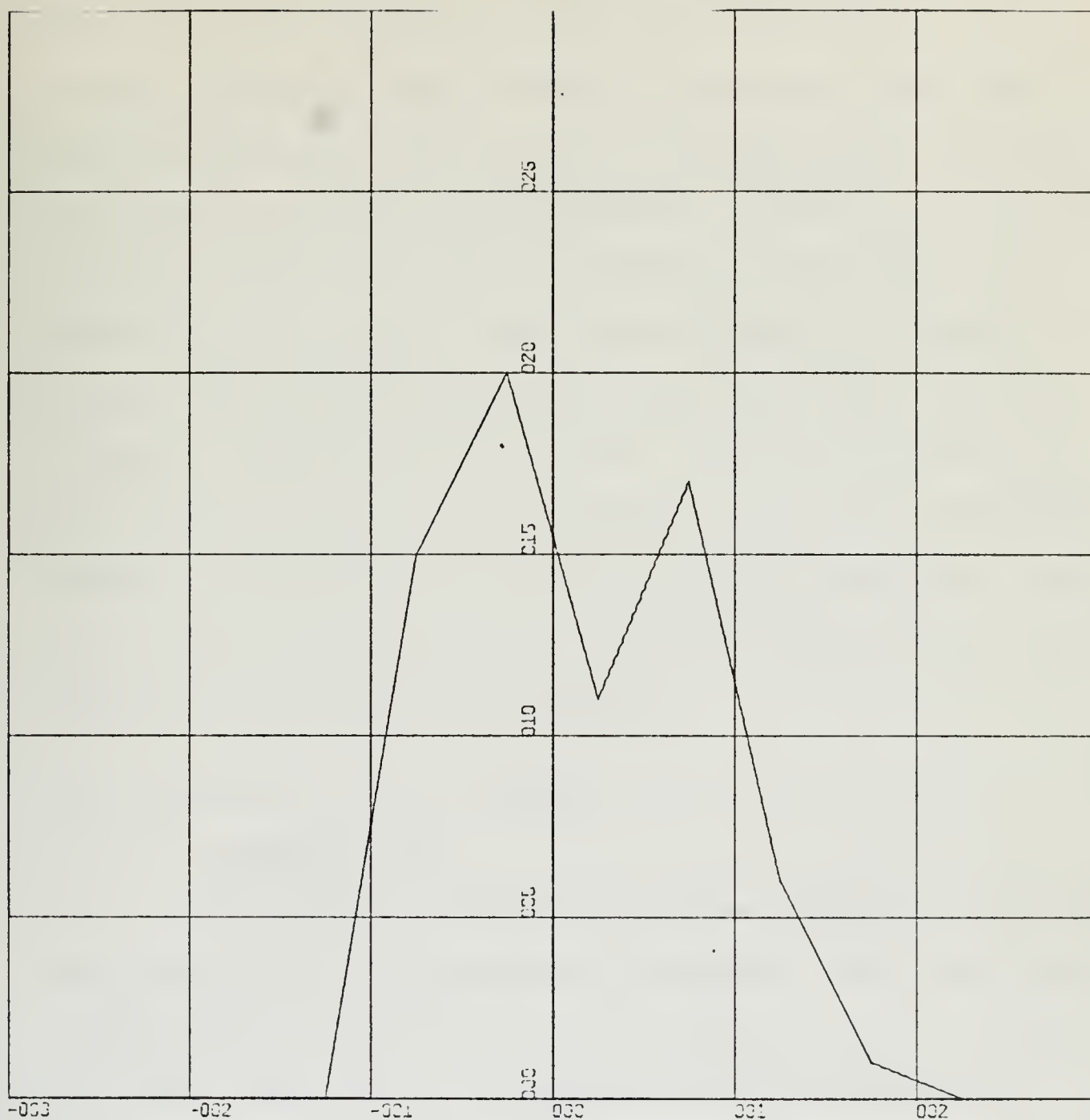
NORMALIZED POWER, DB

POINTS AT THAT POWER

-4.25	0.0
-3.75	0.0
-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	0.0
-1.25	0.0
-0.75	0.0
-0.25	10.0
0.25	6.0
0.75	6.0
1.25	5.0
1.75	1.0
2.25	0.0
2.75	1.0
3.25	0.0
3.75	1.0
4.25	1.0
	0.0

NEGATIVE VALUES MEAN	=	-0.78
POSITIVE VALUES MEAN	=	0.83
NEGATIVE VARIANCE	=	0.06
POSITIVE VARIANCE	=	1.28
NEGATIVE STANDARD DEVIATION	=	0.25
POSITIVE STANDARD DEVIATION	=	1.13

Figure 4. Computer Output "DISTRIBUTION."



X-SCALE=1.00E+00 UNITS INCH.
 Y-SCALE=5.00E+00 UNITS INCH.
 DISTRIBUTION RUN67 ROLL05 PITCH00
 COURSE 180 E&M DIR. 144 DIST 4.17

Figure 5. Graphical Output of Computer Program "DISTRIBUTION."

Figure 6 and Figure 7. Graphical output is contained in Figure 8. This computer program is very similar to the previous program. The same data points are input. The program subtracts each data point from the previous point to obtain the peak to peak variation. There is no need to normalize this data since the values do not depend upon absolute signal level. They depend upon the change in signal level. The program next quantizes the values and a graph of this result is output. Thus the location of peak to peak variations is analyzed. Next the distribution function of the peak to peak variations is computed. From this portion a probabilistic estimate of how large a variation can be expected is obtained.

C. SIMULATION OF THE PROBLEM

1. Program Set up

The computer simulation of the problem was programmed for use on the AGT-10 graphics terminals. The basic equations used were taken from two technical reports, "Predicting Long-Term Operational Parameters of High-Frequency Sky Wave Telecommunication Systems" (ESSA-ERL-110-ITS78) and "Power Gains for Antennas Over Lossy Plane Ground" (ESSA-ERL-104-ITS74). The programs predict how antenna patterns will vary as a ship rolls and pitches over a smooth sea surface. The first parameter that must be input on the graphics terminal is the antenna type. A vertical monopole, inverted L, sloping long wire, vertical monopole with ground screen, vertical half rhombic or a dipole may be chosen. Next antenna length,

VARIATIONS RUN54 ROLL06 PITCH03
COURSE 000 E&M DIR. 149 DIST 10.94

VARIATIONS									
-4.0	2.5	-1.5	2.0	-2.5	1.5	-3.5	-1.5	5.0	-3.5
2.0	-2.5	4.5	-2.5	2.0	-3.0	2.5	-2.5	1.0	-2.5
2.5	-1.5	2.0	-2.5	3.5	-3.0	1.0	-2.0	2.5	-1.0
1.0	-2.5	3.0	-3.5	2.5	-1.5	1.5	-1.0	2.5	-3.0
2.0	-1.0	1.0	-1.5	1.0	-1.5	3.0	-2.5	2.5	-2.0
4.5	-4.5	2.5	-3.0	1.5	-1.5	1.0	-2.0	5.5	-5.0
3.5	-2.5	1.0	-1.5	3.5	-5.5	3.5	-3.5	5.5	-6.0

AVE. VARIATION = -0.1DB STANDARD DEVIATION = 8.4

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-6.25	0.0
-5.75	1.0
-5.25	1.0
-4.75	1.0
-4.25	1.0
-3.75	1.0
-3.25	4.0
-2.75	4.0
-2.25	9.0
-1.75	3.0
-1.25	8.0
-0.75	3.0
-0.25	0.0
0.25	0.0
0.75	0.0
1.25	7.0
1.75	3.0
2.25	5.0
2.75	8.0
3.25	2.0
3.75	4.0
4.25	0.0
4.75	2.0
5.25	1.0
5.75	2.0
6.25	0.0

NEGATIVE VALUES MEAN	=	-2.62
POSITIVE VALUES MEAN	=	2.54
NEGATIVE VARIANCE	=	1.53
POSITIVE VARIANCE	=	1.72
NEGATIVE STANDARD DEVIATION	=	1.24
POSITIVE STANDARD DEVIATION	=	1.31

Figure 6. Computer Output "VARIATIONS."

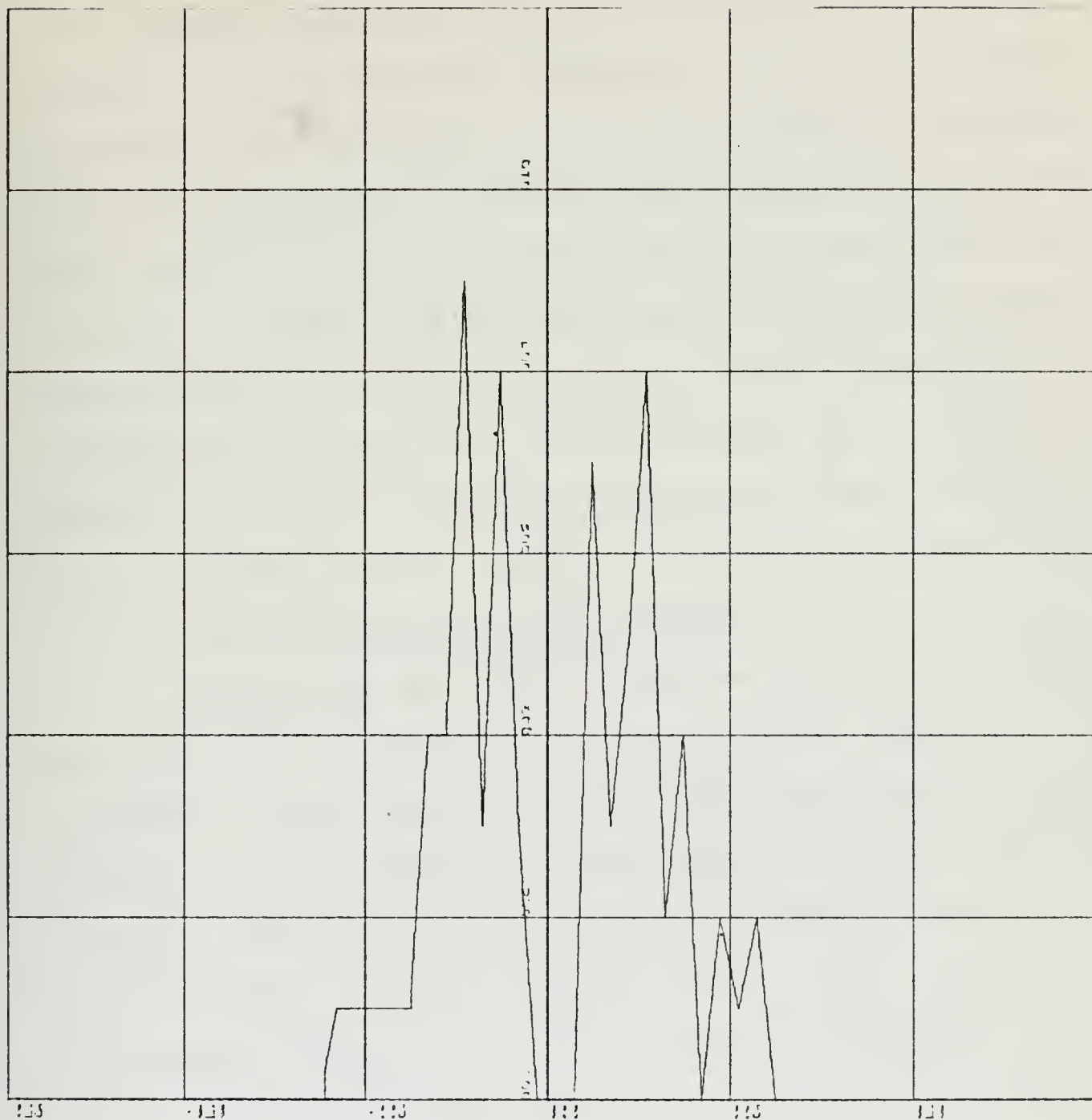
VARIATIONS RUN54 ROLL06 PITCH03
COURSE 000 E&M DIR. 149 DIST 10.94

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

6.00	1.000
5.50	0.957
5.00	0.929
4.50	0.886
4.00	0.871
3.50	0.800
3.00	0.714
2.50	0.543
2.00	0.343
1.50	0.257
1.00	0.043
0.50	0.0

Figure 7. Probability Output of Computer
Program "VARIATIONS."



K-SCALE=5.00E+00 UNITS INCH.

Y-SCALE=2.00E+00 UNITS INCH.

VARIATIONS RUN54 ROLL06 PITCH03

COURSE 000 E&M DIR. 149 DIST 10.94

Figure 8. Graphical Output of Computer Program "VARIATIONS."

height above the sea, and orientation on the ship are input. Other inputs establish frequency, direction of the incoming signal, and environmental constants. The program outputs a plot of the vertical and horizontal antenna patterns at the point designated, incoming signal strength, and maximum gain of the antenna in that position. The sea state input and the direction of sea input determine maximum roll and pitch angles. The ship rolls from an upright position, to a maximum roll and pitch, through upright to the other maximum, and back to upright in thirty six equal intervals. Data is output for the antenna orientation on each interval.

2. Use of Program in this Problem

Because of the way the program equations are set up, the vertical monopole over ground plane cannot be elevated to any height above the surface of the sea. Therefore the present problem was simulated using the dipole antenna. This approximation was made since a vertical monopole over a perfect ground is essentially a center fed dipole when the image of the monopole is considered. Thus the actual problem would be a dipole sixty feet over the surface, and its image sixty feet below the surface if the ground plane were perfect. Major problems occur when the antenna is exactly upright. The program blows up at the boundary conditions. This is why the zero roll zero pitch condition was avoided in the output. This is also why output values were much higher in the zero roll runs.

IV. EXPERIMENTAL RESULTS

A. STRIP RECORDER PLOT

The strip recorder plot of received signal strength provided interesting data even before numbers were considered. Figure 9 shows signal variations over a choppy sea with no large swells. Figure 10 shows signal variations over a sea with large swells but little choppiness. Figure 11 shows both large swells and choppiness. In all three cases the signal strength graphs resembled the surface of the sea for the condition being observed.

B. DISTRIBUTIONAL ANALYSIS

The distributional analysis conformed quite well to the general theory proposed. In most cases the received signal was characterized by a gradual increase to a peak, followed by a decrease to approximately the mean value of incoming signal, followed by another peak and a gradual decrease. There were definitely two intervals between which the signal strength swung most frequently. The gradual decrease on both sides of the peaks further shows the large variation with a small variable factor possibly caused by the randomness of the sea. This variable factor could also be attributed to the fact that on any run the ship would not roll to the same angle every time. The run might be estimated to have a 5° roll overall, but any



ANTENNA SIMULATION

LENGTH OF ANTENNA = .95 METERS
 HEIGHT OF ANTENNA = 18.2 METERS
 PHI OF ANTENNA = 000 DEGREES RELATIVE
 THETA OF ANTENNA = 000 DEGREES RELATIVE
 FREQUENCY = 149.0 MHZ
 EPSILON = 80.0
 SIGMA = 5.0
 PHI OF PLOT = 306 DEGREES RELATIVE
 THETA OF PLOT = 089 DEGREES RELATIVE
 SEA STATE = 2
 DIRECTION OF SEA = 018 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
.9	.0	4.875
1.7	.0	1.452
2.5	.0	1.490
3.2	.0	2.809
3.8	.0	3.353
4.3	.0	2.852
4.6	.0	2.319
4.9	.0	2.058
4.9	.0	1.989
4.9	.0	2.058
4.6	.0	2.319
4.3	.0	2.852
3.8	.0	3.353
3.2	.0	2.809
2.5	.0	1.490
1.7	.0	1.452
.9	.0	4.875
-.9	.0	5.080
-1.7	.0	1.592
-2.5	.0	1.416
-3.2	.0	2.594
-3.8	.0	3.332
-4.3	.0	3.054
-4.6	.0	2.564
-4.9	.0	2.275
-4.9	.0	2.190
-4.9	.0	2.275
-4.6	.0	2.564
-4.3	.0	3.054
-3.8	.0	3.332
-3.2	.0	2.594
-2.5	.0	1.416
-1.7	.0	1.592
-.9	.0	5.080

AVERAGE VALUE = 2.66 DB

Figure 9. Output of Computer Program "ANTENNA SIMULATION."

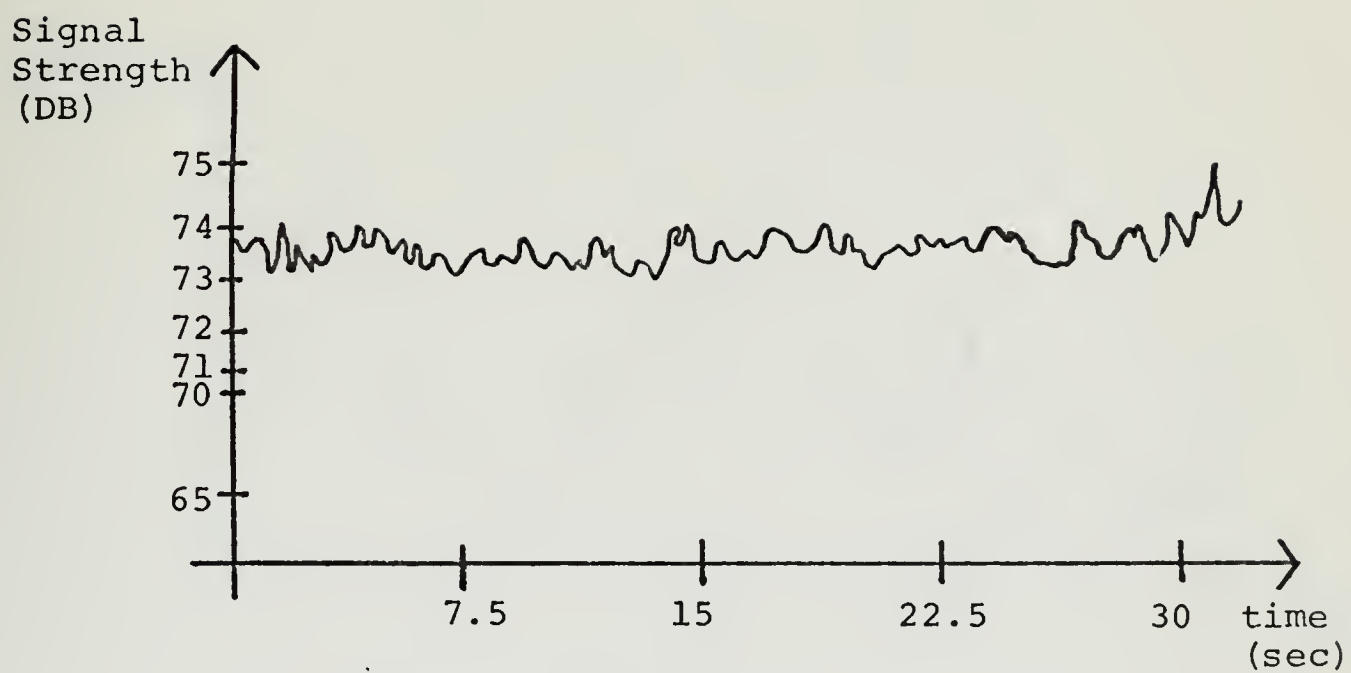


Figure 10. Signal Variations Over a Choppy Sea with No Large Swells.

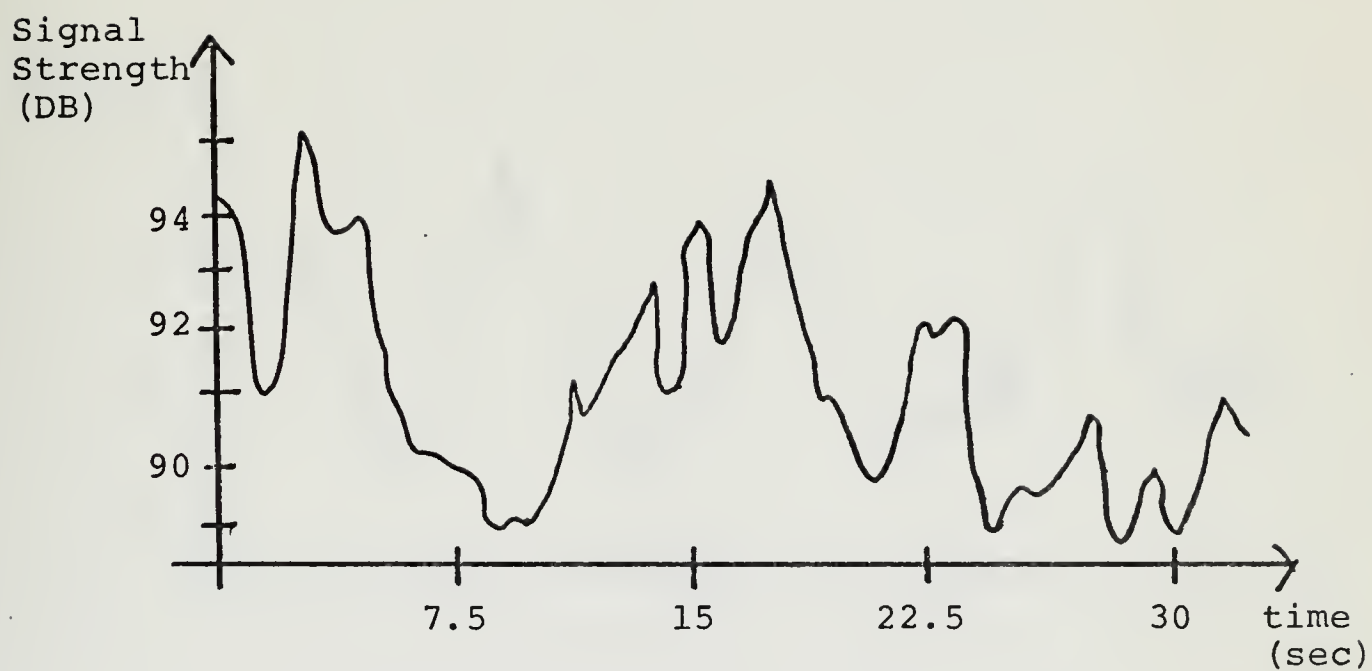


Figure 11. Signal Variations Over a Sea with Large Swells but No Choppiness.

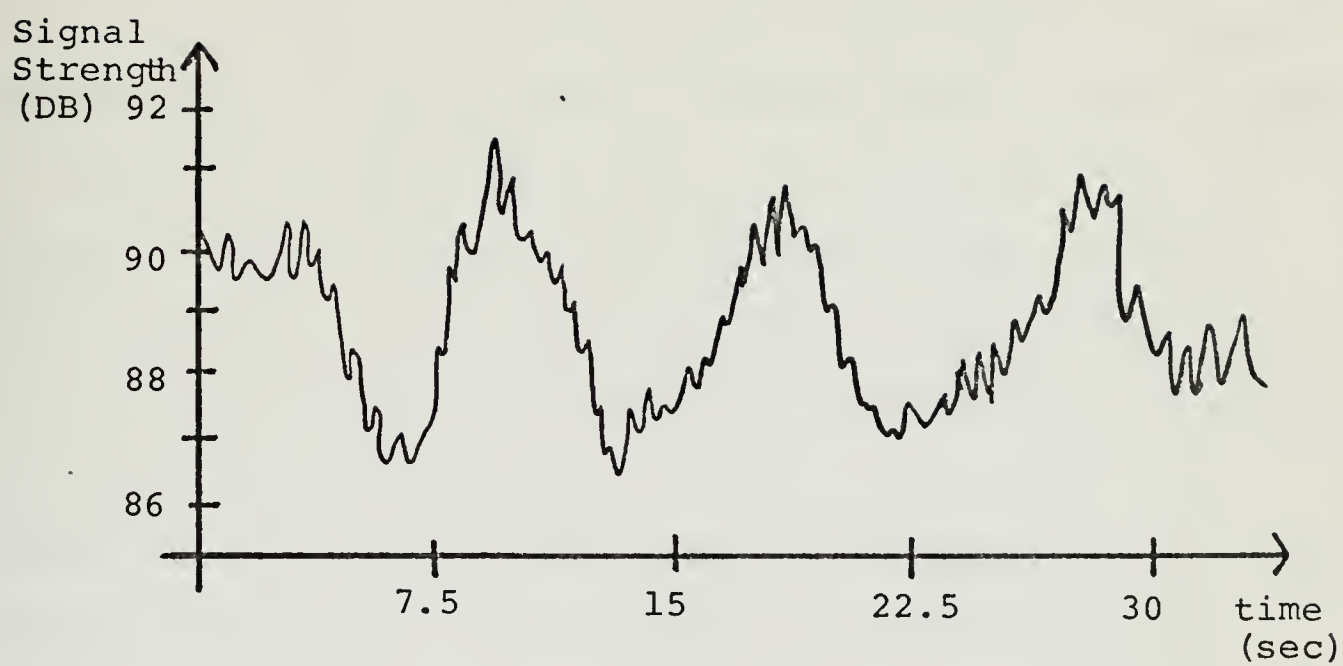


Figure 12. Signal Variations over a Choppy Sea with Large Swells.

individual roll might be 5.2° or 3° or 7° . Runs were not extremely long so that roll and pitch could be updated more often, but they could not be made very short because small sample sections can lead to very erroneous conclusions. By looking only at the distributional analysis no relationship between roll and pitch conditions is immediately obvious. Peaks occur on each plot, but they are unrelated to roll and pitch. Mean and variance also show no logical progression. But this kind of correspondence cannot really be expected. Signal strength is too dependent upon the direction from which the electromagnetic waves originate. When receiving from a point directly astern and taking 5° rolls the variations might be fairly small. This in no way indicates that when taking 5° rolls and receiving from abeam the signal will still vary only slightly. Therefore when looking only at the distributional analysis, the validity of each run is the question. To answer this question many runs under the same conditions on different days are necessary. Due to the long time necessary to hand digitize the data this problem could not be undertaken.

C. VARIATIONAL ANALYSIS

The results of the variational analysis follow closely the results of the distributional analysis. The same two peak behavior shows up on the graphs, with the same type gradual decrease around the peaks. The average value of the data points is always very close to zero. This shows that the runs were short enough so that the average signal

strength was constant. Again because of the number of variable factors involved, neither the peaks or the probability computations show any easily definable trend. Also the lack of many runs under the same conditions leaves the validity of the data in question. The shape of the output graphs conforms well to the proposed theory however. It is only the degree of accuracy of the numbers, and the predictability of the peaks that is in doubt.

D. SIMULATION ANALYSIS

The computer simulation of the problem was an attempt to tie all the previous analysis together. The program did not include the randomness of the sea, but it was hoped the program could predict where the peaks in distributional and variational analysis should occur. The program failed to accomplish this task. As the ship rolled through a complete cycle, the program predicted several peaks in signal strength. One of the peaks corresponded to the major peak in the actual data, but with that many peaks, one of them had to match. According to the simulation, three equal peaks should show on each side of the mean. From these results the smooth surface approximation seems doomed to failure. The rough surface seems to smooth out the antenna pattern so that instead of going from a maximum to a null as the ship rolls, the pattern goes from a lesser maximum to a minimum higher than a null. Because of this, on the average the signal varies between two points. The rough surface makes the result more predictable in a more

random way, more predictable since there is only one average value to which the signal varies, but more random since all values around that average are possible.

E. SHORTCOMINGS OF ANALYSIS

The two major drawbacks in this analysis were the accuracy of the measurements, especially roll and pitch, and the necessity to hand digitize the data. Roll and pitch values were estimates, and the accuracy of signal strength measurements was limited to $\pm .25$ DB. If on two different runs the peaks were in the same spot on the computer outputs, the peaks could be as much as .5 DB apart in reality. The lack of self-digitizing equipment prevented many runs from being analyzed. This also prevented any attempt at a frequency analysis of the data. Further analysis of the problem should include many runs under identical conditions instead of runs under many conditions. In this way the predictability of signal variations can be established. Once this is accomplished, different runs can be added in search of a method to predict the result.

V. CONCLUSIONS

As a ship rolls and pitches, signal strength will, on the average, vary between two values. The magnitude of these variations is dependent first of all upon sea state, since this determines the height of the large ocean swells. The variations also depend upon wind speed since this determines choppiness. A third dominant factor is the relative direction from which the signal is being received. A smooth surface approximation is not justified since the rough surface reflections have a smoothing effect on the antenna pattern which modifies the magnitude and the frequency of the variations.

APPENDIX A ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLOT	=	036 DEGREES RELATIVE
THETA OF PLOT	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	039 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
-------------------	--------------------	-------------------------

1.7	.9	1.380
3.4	1.7	3.231
5.0	2.5	1.965
6.5	3.2	2.670
7.7	3.8	2.494
8.7	4.3	2.041
9.5	4.7	2.364
9.9	4.9	2.606
10.1	5.0	2.653
9.9	4.9	2.606
9.5	4.7	2.364
8.7	4.3	2.041
7.7	3.8	2.494
6.5	3.2	2.670
5.0	2.5	1.965
3.4	1.7	3.231
1.7	.9	1.380
-1.7	-.9	1.495
-3.4	-1.7	3.035
-5.0	-2.5	2.109
-6.5	-3.2	2.431
-7.7	-3.8	2.675
-8.7	-4.3	2.051
-9.5	-4.7	2.141
-9.9	-4.9	2.381
-10.1	-5.0	2.461
-9.9	-4.9	2.381
-9.5	-4.7	2.141
-8.7	-4.3	2.051
-7.7	-3.8	2.675
-6.5	-3.2	2.431
-5.0	-2.5	2.109
-3.4	-1.7	3.035
-1.7	-.9	1.495

AVERAGE VALUE = 2.33 DB

DISTRIBUTION RUN 8 ROLL10 PITCH05
 COURSE 180 E&M DIR. 144 DIST 4.17

DATA POINTS

75.0	73.5	74.5	73.0	75.0	72.5	74.0	72.5	74.0
72.5	74.0	73.0	74.0	72.5	74.0	72.5	74.0	73.0
74.0	73.0	74.0	73.5	74.5	73.5	74.5	73.5	74.5
73.5	74.5	73.5	77.0	73.5	74.5	73.0	76.0	73.0
74.0	73.0	75.5	73.0	75.0	73.0	75.0	72.5	75.0
73.0	75.0	73.0	74.5	73.0	74.0	72.5	74.5	73.0
74.5	73.0							

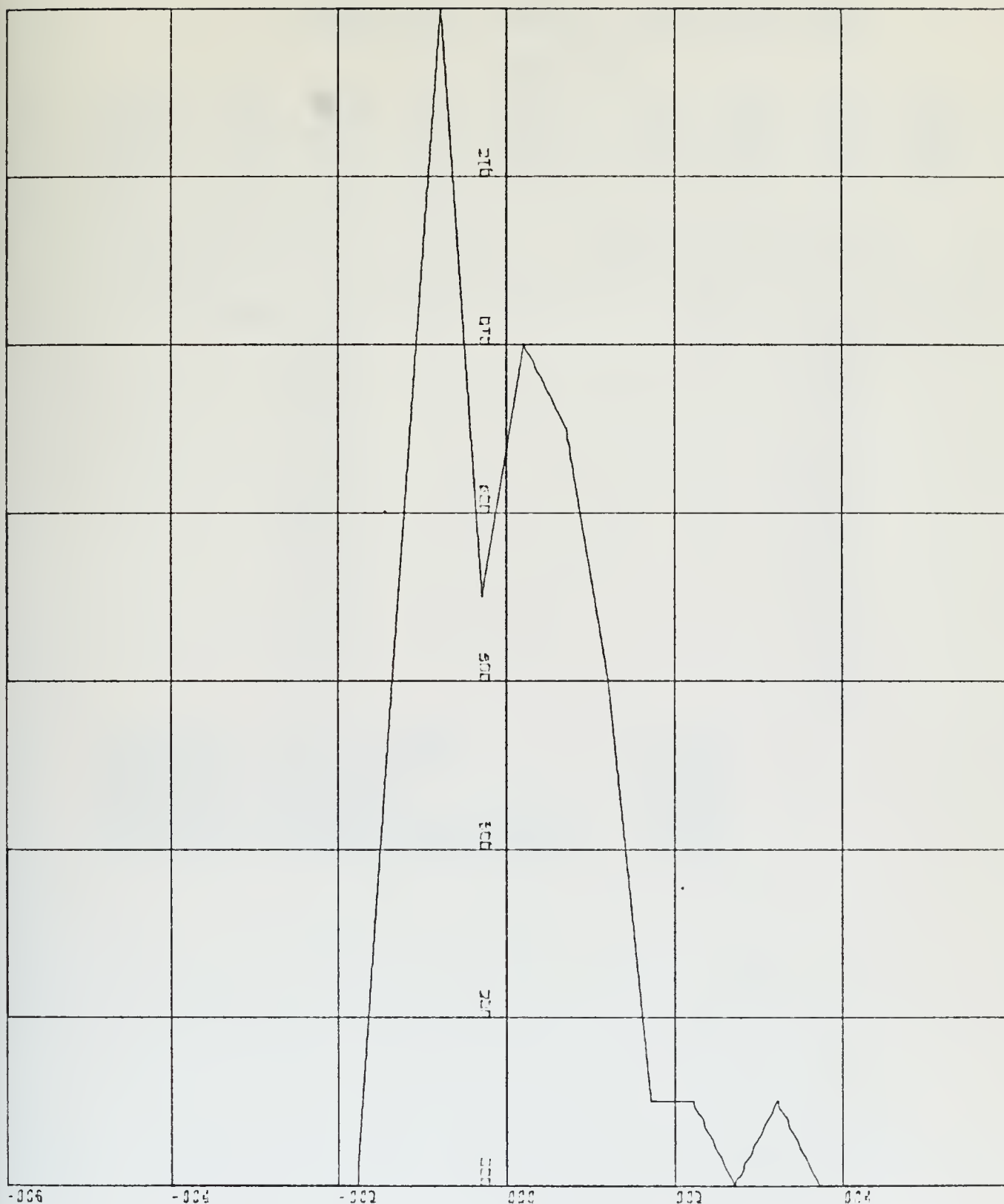
AVERAGE POWER = 73.8DB STANDARD DEVIATION = 1.0

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB POINTS AT THAT POWER

-4.25	0.0
-3.75	0.0
-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	0.0
-1.25	7.0
-0.75	14.0
-0.25	7.0
0.25	10.0
0.75	9.0
1.25	6.0
1.75	1.0
2.25	1.0
2.75	0.0
3.25	1.0
3.75	0.0
4.25	0.0

NEGATIVE VALUES MEAN = -0.80
 POSITIVE VALUES MEAN = 0.80
 NEGATIVE VARIANCE = 0.13
 POSITIVE VARIANCE = 0.49
 NEGATIVE STANDARD DEVIATION = 0.36
 POSITIVE STANDARD DEVIATION = 0.70



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=2.00E+00 UNITS INCH.

DISTRIBUTION RUN 8 ROLL10 PITCH05

COURSE 180 E&M DIR. 144 DIST 4.17

VARIATIONS RUN 8 ROLL10 PITCH05
 COURSE 180 E&M DIR. 144 DIST 4.17

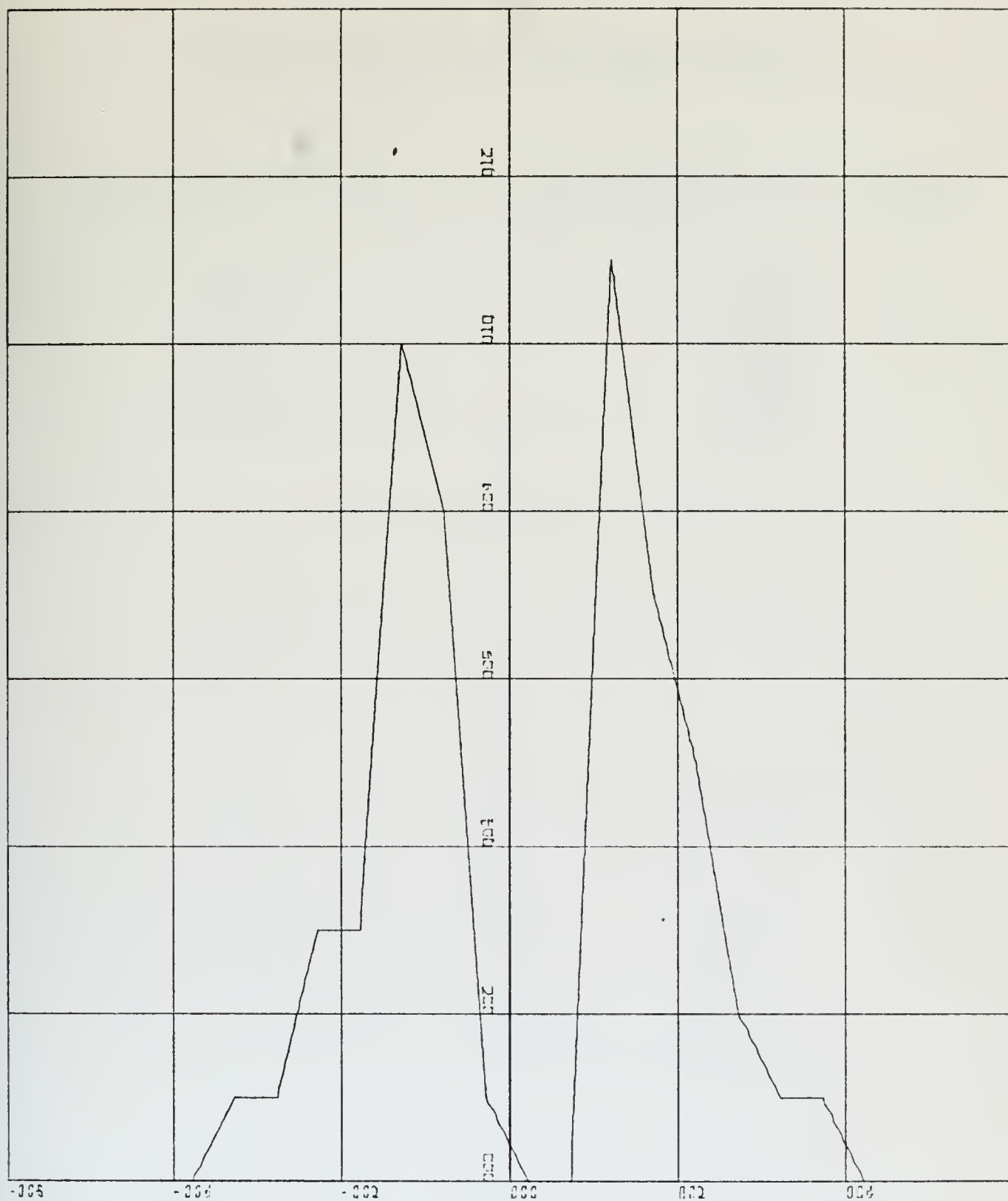
VARIATIONS									
-1.5	1.0	-1.5	2.0	-2.5	1.5	-1.5	1.5	-1.5	1.5
-1.0	1.0	-1.5	1.5	-1.5	1.5	-1.0	1.0	-1.0	1.0
-0.5	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	3.5
-3.5	1.0	-1.5	3.0	-3.0	1.0	-1.0	2.5	-2.5	2.0
-2.0	2.0	-2.5	2.5	-2.0	2.0	-2.0	1.5	-1.5	1.0
-1.5	2.0	-1.5	1.5						

AVE. VARIATION = -0.0DB STANDARD DEVIATION = 3.1

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-4.25	0.0
-3.75	0.0
-3.25	1.0
-2.75	1.0
-2.25	3.0
-1.75	3.0
-1.25	10.0
-0.75	8.0
-0.25	1.0
0.25	0.0
0.75	0.0
1.25	11.0
1.75	7.0
2.25	5.0
2.75	2.0
3.25	1.0
3.75	1.0
4.25	0.0

NEGATIVE VALUES MEAN	=	-1.61
POSITIVE VALUES MEAN	=	1.59
NEGATIVE VARIANCE	=	0.49
POSITIVE VARIANCE	=	0.46
NEGATIVE STANDARD DEVIATION	=	0.70
POSITIVE STANDARD DEVIATION	=	0.68



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=2.00E+00 UNITS INCH.

VARIATIONS RUN 8 ROLL 10 PITCH 05

COURSE 180 E&M DIR. 144 DIST 4.17

VARIATIONS RUN 8 ROLL10 PITCH05
COURSE 180 E&M DIR. 144 DIST 4.17

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

4.00	1.000
3.50	0.981
3.00	0.944
2.50	0.889
2.00	0.741
1.50	0.556
1.00	0.167
0.50	0.019

ANTENNA SIMULATION

LENGTH OF ANTENNA # .95 METERS
 HEIGHT OF ANTENNA = 18.2 METERS
 PHI OF ANTENNA = 000 DEGREES RELATIVE
 THETA OF ANTENNA = 000 DEGREES RELATIVE
 FREQUENCY = 149.0 MHZ
 EPSILON = 80.0
 SIGMA = 5.0
 PHI OF PLOT = 126 DEGREES RELATIVE
 THETA OF PLOT = 089 DEGREES RELATIVE
 SEA STATE = 2
 DIRECTION OF SEA = 039 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
1.7	.9	1.377
3.4	1.7	3.218
5.0	2.5	1.937
6.5	3.2	2.623
7.7	3.8	2.425
8.7	4.3	1.954
9.5	4.7	2.261
9.9	4.9	2.492
10.1	5.0	2.536
9.9	4.9	2.492
9.5	4.7	2.261
8.7	4.3	1.954
7.7	3.8	2.425
6.5	3.2	2.623
5.0	2.5	1.937
3.4	1.7	3.218
1.7	.9	1.377
-1.7	-.9	1.490
-3.4	-1.7	3.018
-5.0	-2.5	2.076
-6.5	-3.2	2.376
-7.7	-3.8	2.598
-8.7	-4.3	1.953
-9.5	-4.7	2.027
-9.9	-4.9	2.255
-10.1	-5.0	2.332
-9.9	-4.9	2.255
-9.5	-4.7	2.027
-8.7	-4.3	1.953
-7.7	-3.8	2.598
-6.5	-3.2	2.376
-5.0	-2.5	2.076
-3.4	-1.7	3.018
-1.7	-.9	1.490

AVERAGE VALUE = 2.27 DB

DISTRIBUTION RUN 9 ROLL10 PITCH05
COURSE 270 E&M DIR. 144 DIST 4.17

DATA POINTS

73.0	72.0	73.0	72.5	73.0	72.5	73.0	72.5	73.0
72.5	73.0	72.5	73.0	72.5	73.0	72.5	73.0	72.5
73.0	72.5	73.0	72.5	73.5	72.5	73.5	72.5	74.0
72.5	74.0	72.5	73.5	72.5	73.5	72.5	73.5	72.5
73.5	72.5	73.5	72.5	74.0	73.0	74.0	73.0	74.0
73.0	73.5	73.0	73.5	72.5	74.0	73.0	74.0	73.0
74.0	73.0	74.0	73.0	74.0	73.0	74.0	73.0	74.0
73.0	74.0	73.0	74.0	73.0	73.5	73.0	73.5	73.0
73.5	73.0	73.5	73.0	73.5	73.0	74.0	72.5	73.5
72.5								

AVERAGE POWER = 73.1DB STANDARD DEVIATION = 0.3

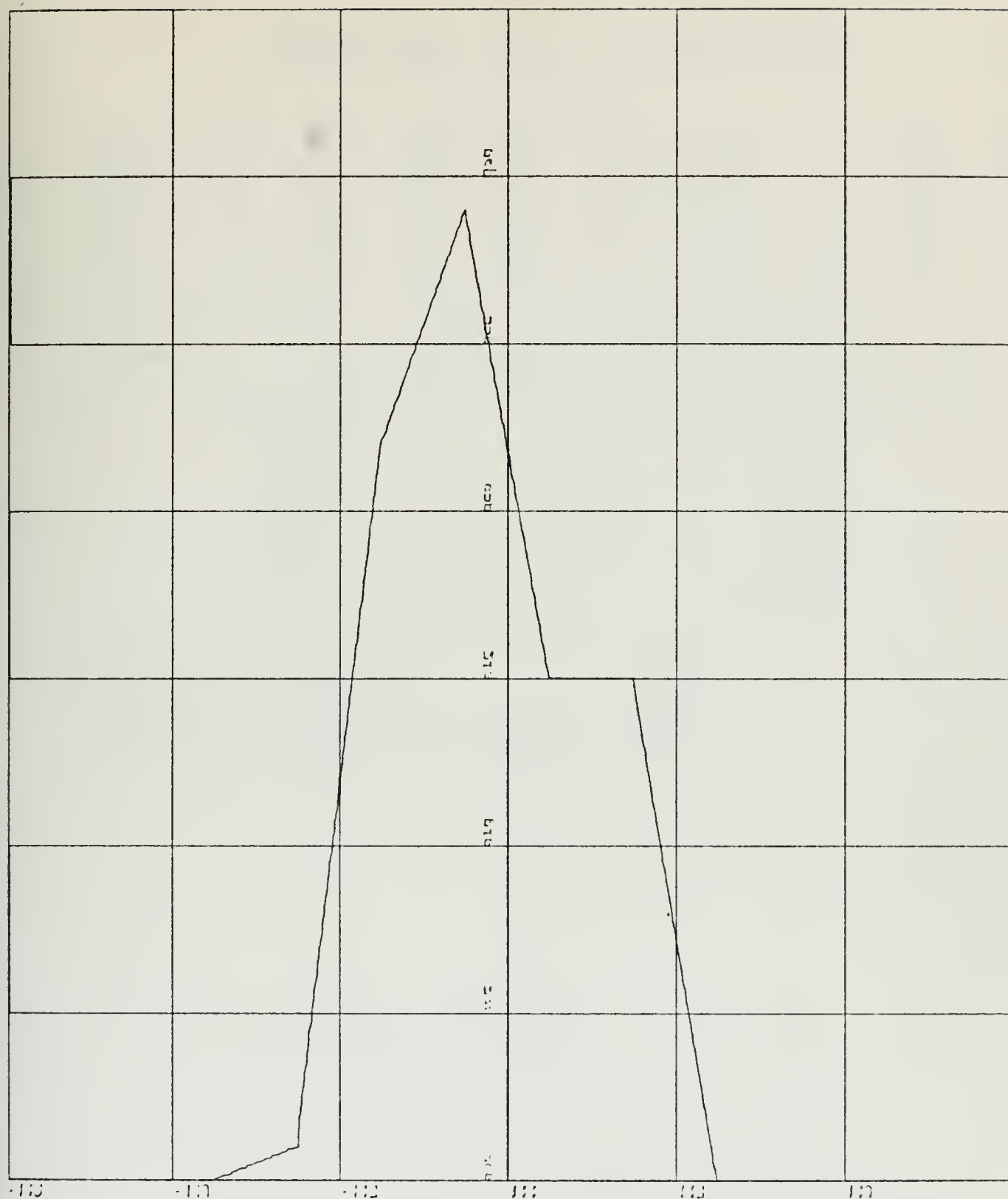
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-2.25	0.0
-1.75	0.0
-1.25	1.0
-0.75	22.0
-0.25	29.0
0.25	15.0
0.75	15.0
1.25	0.0
1.75	0.0
2.25	0.0

NEGATIVE VALUES MEAN	=	-0.36
POSITIVE VALUES MEAN	=	0.62
NEGATIVE VARIANCE	=	0.07
POSITIVE VARIANCE	=	0.06
NEGATIVE STANDARD DEVIATION	=	0.27
POSITIVE STANDARD DEVIATION	=	0.25



K-SCALE=1.00E+00 UNITS INCH.

V-SCALE=5.00E+00 UNITS INCH.

DISTRIBUTION RUN 9 ROLL 10 PITCH 05

COURSE 270 E&M DIR. 144 DIST 4.17

VARIATIONS RUN 9 ROLL10 PITCH05
 COURSE 270 E&M DIR. 144 DIST 4.17

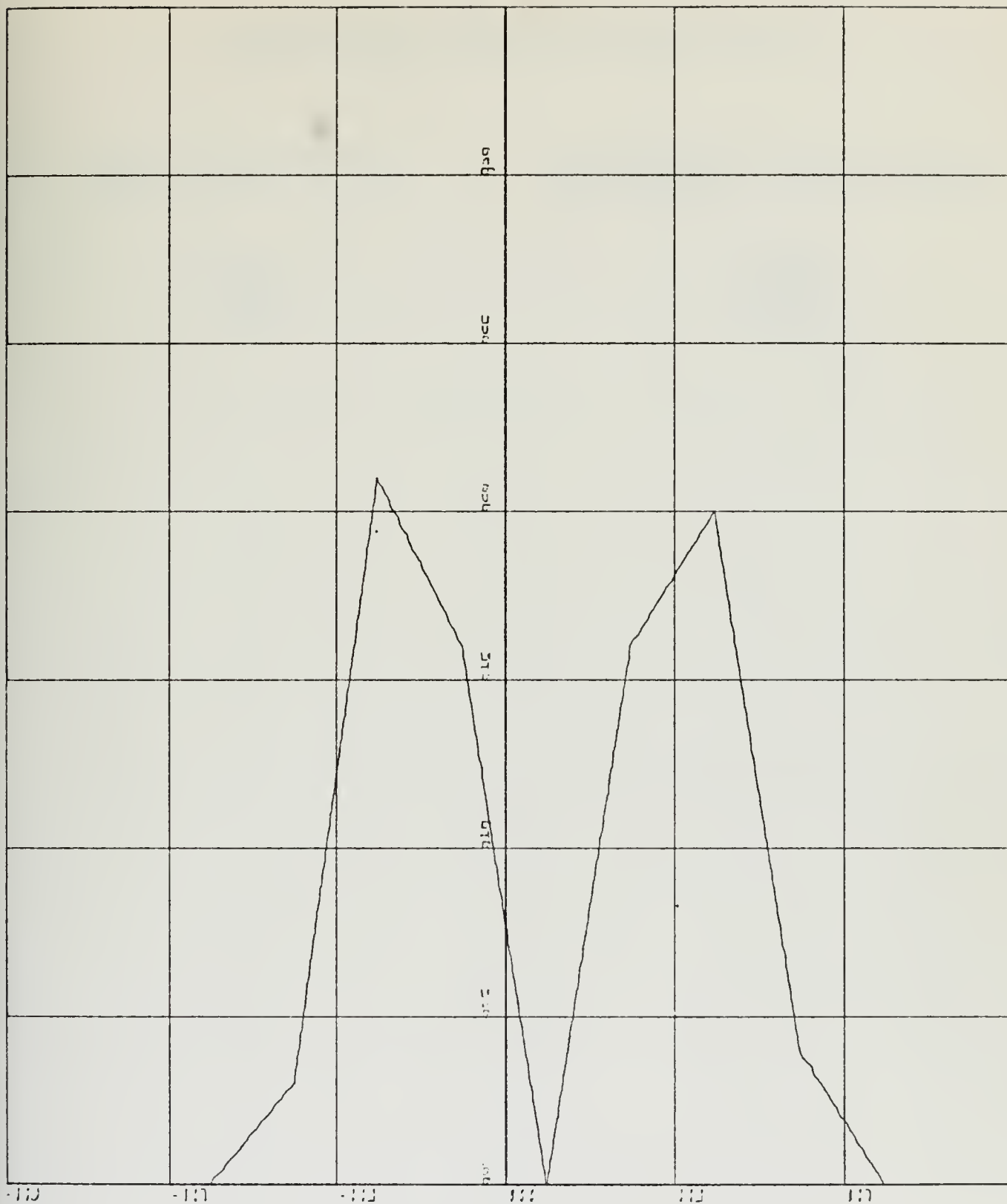
VARIATIONS									
-1.0	1.0	-0.5	0.5	-0.5	0.5	-0.5	0.5	-0.5	0.5
-0.5	0.5	-0.5	0.5	-0.5	0.5	-0.5	0.5	-0.5	0.5
-0.5	1.0	-1.0	1.0	-1.0	1.5	-1.5	1.5	-1.5	1.0
-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.5
-1.0	1.0	-1.0	1.0	-1.0	0.5	-0.5	0.5	-1.0	1.5
-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.0
-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	0.5	-0.5	0.5
-0.5	0.5	-0.5	0.5	-0.5	0.5	-0.5	1.0	-1.5	1.0

AVE. VARIATION = 0.0DB STANDARD DEVIATION = 0.8

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-2.25	0.0
-1.75	0.0
-1.25	3.0
-0.75	21.0
-0.25	16.0
0.25	0.0
0.75	16.0
1.25	20.0
1.75	4.0
2.25	0.0

NEGATIVE VALUES MEAN	=	-0.84
POSITIVE VALUES MEAN	=	0.85
NEGATIVE VARIANCE	=	0.09
POSITIVE VARIANCE	=	0.11
NEGATIVE STANDARD DEVIATION	=	0.31
POSITIVE STANDARD DEVIATION	=	0.32



K-SCALE=1.00E+00 UNITS INCH.

K-SCALE=5.00E+00 UNITS INCH.

VARIATIONS RUN 9 ROLL 10 PITCH 05

COURSE 270 E&M DIR. 144 DIST 4.17

VARIATIONS RUN 9 ROLL10 PITCH05
COURSE 270 E&M DIR. 144 DIST 4.17

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

2.00
1.50
1.00
0.50

1.000
0.950
0.662
0.200

ANTENNA SIMULATION

LENGTH OF ANTENNA = .95 METERS
 HEIGHT OF ANTENNA = 18.2 METERS
 PHI OF ANTENNA = 000 DEGREES RELATIVE
 THETA OF ANTENNA = 000 DEGREES RELATIVE
 FREQUENCY = 149.0 MHZ
 EPSILON = 80.0
 SIGMA = 5.0
 PHI OF PLOT = 189 DEGREES RELATIVE
 THETA OF PLOT = 089 DEGREES RELATIVE
 SEA STATE = 2
 DIRECTION OF SEA = 039 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
1.7	1.4	1.379
3.4	2.7	3.231
5.0	4.0	1.980
6.5	5.1	2.677
7.7	6.1	2.547
8.7	6.9	2.079
9.5	7.5	2.383
9.9	7.9	2.636
10.1	8.0	2.693
9.9	7.9	2.636
9.5	7.5	2.383
8.7	6.9	2.079
7.7	6.1	2.547
6.5	5.1	2.677
5.0	4.0	1.980
3.4	2.7	3.231
1.7	1.4	1.379
-1.7	-1.4	1.501
-3.4	-2.7	3.047
-5.0	-4.0	2.145
-6.5	-5.1	2.459
-7.7	-6.1	2.752
-8.7	-6.9	2.135
-9.5	-7.5	2.201
-9.9	-7.9	2.437
-10.1	-8.0	2.520
-9.9	-7.9	2.437
-9.5	-7.5	2.201
-8.7	-6.9	2.135
-7.7	-6.1	2.752
-6.5	-5.1	2.459
-5.0	-4.0	2.145
-3.4	-2.7	3.047
-1.7	-1.4	1.501

AVERAGE VALUE = 2.36 DB

DISTRIBUTION RUN 10 ROLL08 PITCH05
 COURSE 334 E&M DIR. 145 DIST 4.58

DATA POINTS

74.0	73.0	74.0	73.0	73.5	73.0	74.0	73.0	74.0
73.5	74.0	72.5	74.5	73.0	74.0	73.0	74.5	73.5
75.0	73.5	74.5	73.5	74.0	73.0	74.0	73.0	74.5
73.0	75.5	73.5	74.5	73.5	74.0	73.5	74.5	73.5

AVERAGE POWER = 73.7DB STANDARD DEVIATION = 0.4

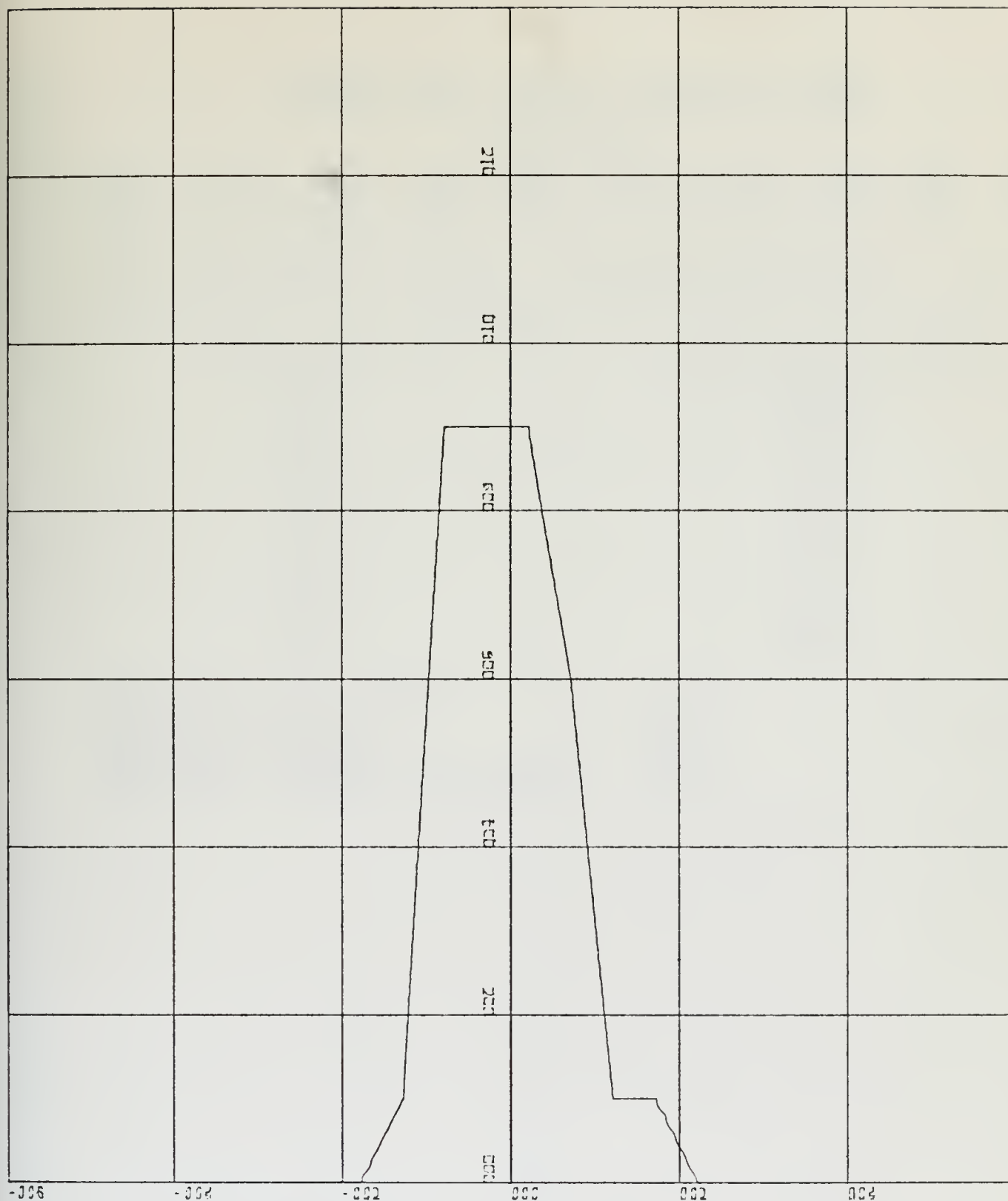
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-2.25	0.0
-1.75	0.0
-1.25	1.0
-0.75	9.0
-0.25	9.0
0.25	9.0
0.75	6.0
1.25	1.0
1.75	1.0
2.25	0.0

NEGATIVE VALUES MEAN	=	-0.53
POSITIVE VALUES MEAN	=	0.59
NEGATIVE VARIANCE	=	0.09
POSITIVE VARIANCE	=	0.19
NEGATIVE STANDARD DEVIATION	=	0.30
POSITIVE STANDARD DEVIATION	=	0.43



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=2.00E+00 UNITS INCH.

DISTRIBUTION RUN 10 ROLLO8 PITCH05

COURSE 334 E&M DIR. 145 DIST 4.58

VARIATIONS RUN 10 ROLL08 PITCH05
COURSE 334 E&M DIR. 145 DIST 4.58

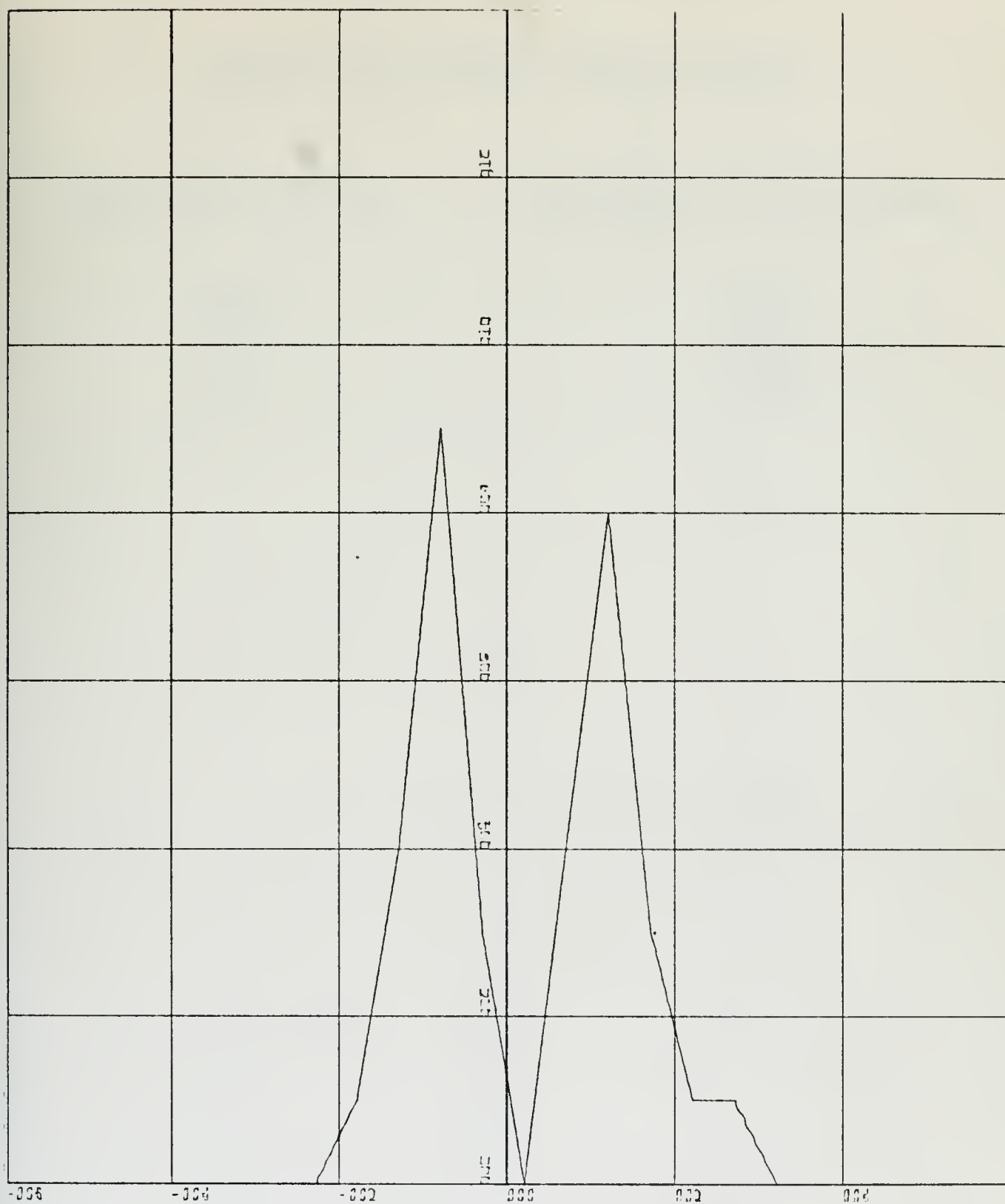
VARIATIONS									
-1.0	1.0	-1.0	0.5	-0.5	1.0	-1.0	1.0	-0.5	0.5
-1.5	2.0	-1.5	1.0	-1.0	1.5	-1.0	1.5	-1.5	1.0
-1.0	0.5	-1.0	1.0	-1.0	1.5	-1.5	2.5	-2.0	1.0
-1.0	0.5	-0.5	1.0						

AVE. VARIATION = 0.008 STANDARD DEVIATION = 1.5

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	1.0
-1.25	4.0
-0.75	9.0
-0.25	3.0
0.25	0.0
0.75	4.0
1.25	8.0
1.75	3.0
2.25	1.0
2.75	1.0
3.25	0.0

NEGATIVE VALUES MEAN	=	-1.09
POSITIVE VALUES MEAN	=	1.12
NEGATIVE VARIANCE	=	0.16
POSITIVE VARIANCE	=	0.30
NEGATIVE STANDARD DEVIATION	=	0.40
POSITIVE STANDARD DEVIATION	=	0.55



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=2.00E+00 UNITS INCH.

VARIATIONS RUN 10 ROLLO8 PITCH05

COURSE 334 E&M DIR. 145 DIST 4.58

VARIATIONS RUN 10 ROLL08 PITCH05
COURSE 334 E&M DIR. 145 DIST 4.58

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

3.00
2.50
2.00
1.50
1.00
0.50

1.000
0.971
0.941
0.824
0.471
0.088

ANTENNA SIMULATION

LENGTH OF ANTENNA = .95 METERS
 HEIGHT OF ANTENNA = 18.2 METERS
 PHI OF ANTENNA = 000 DEGREES RELATIVE
 THETA OF ANTENNA = 000 DEGREES RELATIVE
 FREQUENCY = 149.0 MHZ
 EPSILON = 80.0
 SIGMA = 5.0
 PHI OF PLOT = 186 DEGREES RELATIVE
 THETA OF PLOT = 089 DEGREES RELATIVE
 SEA STATE = 5
 DIRECTION OF SEA = 007 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
.8	2.6	4.967
1.7	5.2	1.477
2.4	7.5	1.364
3.1	9.7	2.547
3.7	11.6	3.223
4.2	13.1	2.912
4.6	14.2	2.407
4.8	14.9	2.100
4.9	15.1	2.007
4.8	14.9	2.100
4.6	14.2	2.407
4.2	13.1	2.912
3.7	11.6	3.223
3.1	9.7	2.547
2.4	7.5	1.364
1.7	5.2	1.477
.8	2.6	4.967
-.8	-2.6	5.168
-1.7	-5.2	1.618
-2.4	-7.5	1.298
-3.1	-9.7	2.320
-3.7	-11.6	3.122
-4.2	-13.1	3.043
-4.6	-14.2	2.634
-4.8	-14.9	2.337
-4.9	-15.1	2.239
-4.8	-14.9	2.337
-4.6	-14.2	2.634
-4.2	-13.1	3.043
-3.7	-11.6	3.122
-3.1	-9.7	2.320
-2.4	-7.5	1.298
-1.7	-5.2	1.618
-.8	-2.6	5.168

AVERAGE VALUE = 2.63 DB

DISTRIBUTION RUN11 ROLLO5 PITCH15
COURSE 334 E&M DIR. 148 DIST 5.85

DATA POINTS

75.0	74.0	76.0	74.5	76.5	74.0	76.0	74.0	76.5
74.0	75.5	74.0	76.0	74.0	75.0	74.0	75.0	73.5
74.5	74.0	74.5	73.0	75.0	74.0	75.5	74.0	75.5
74.0	75.0	74.0	75.5	74.0	75.0	74.0	76.0	74.0
76.5	74.5	76.0	75.0	76.0	75.0	76.0	75.5	77.0
74.5	75.5	74.5	75.5	74.5	75.5	74.5	75.5	74.5
75.5	74.5	75.5	74.0	75.5	74.0	76.0	74.0	75.0
74.0	75.0	74.0	75.0	74.0	75.0	74.0	75.0	74.0
75.0	73.5	75.0	74.0	75.0	74.0	74.5	74.0	75.5
74.0	75.5	74.5	76.5	74.0	76.5	74.5	75.5	74.0
76.0	74.0	75.0	74.0	76.0	74.5	76.0	74.5	75.5
74.0	75.5	75.0	75.5	74.5	75.0	74.5		

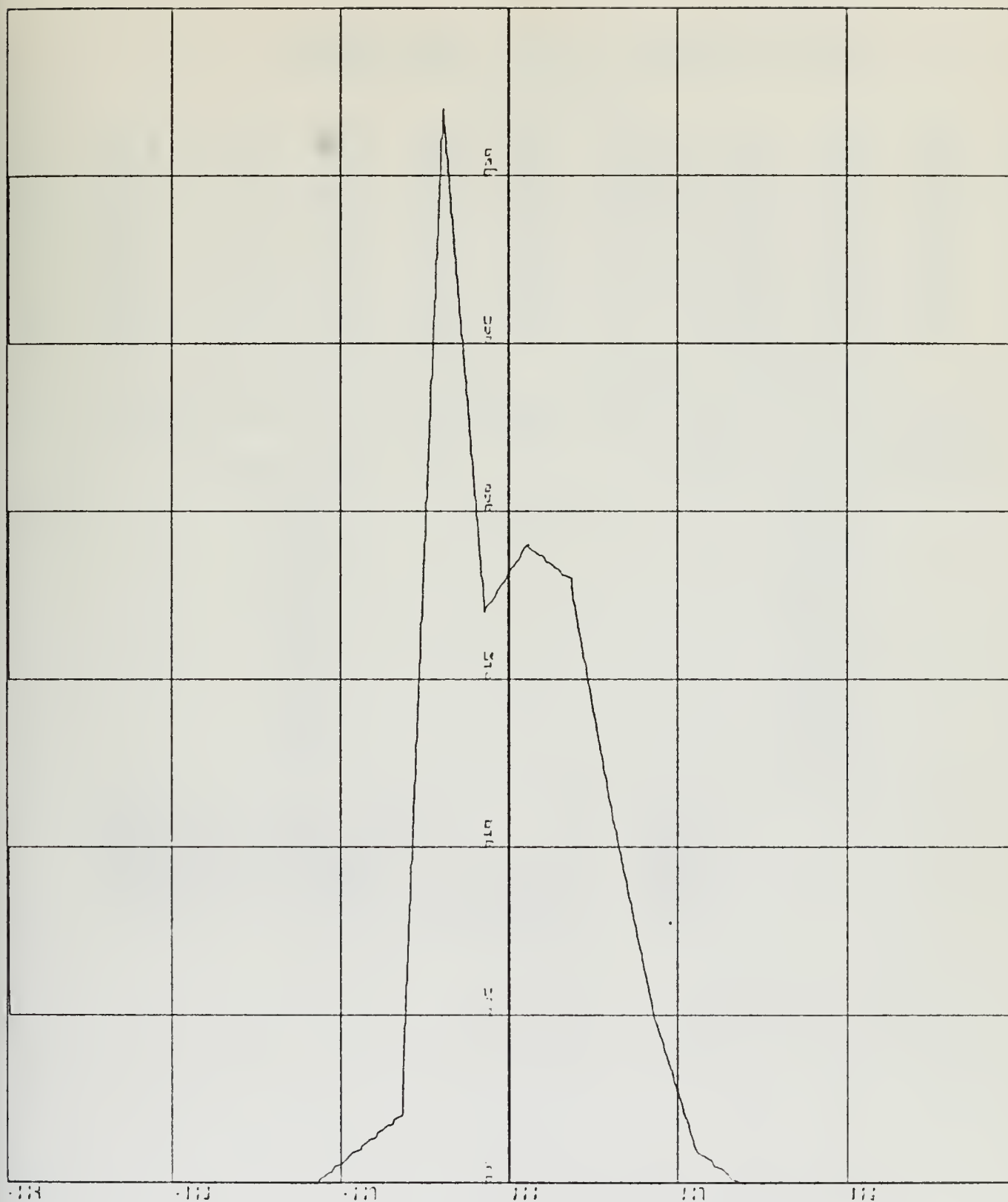
AVERAGE POWER = 74.8DB STANDARD DEVIATION = 0.7

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB POINTS AT THAT POWER

-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	1.0
-1.25	2.0
-0.75	32.0
-0.25	17.0
0.25	19.0
0.75	18.0
1.25	11.0
1.75	5.0
2.25	1.0
2.75	0.0
3.25	0.0

NEGATIVE VALUES MEAN = -0.72
POSITIVE VALUES MEAN = 0.70
NEGATIVE VARIANCE = 0.10
POSITIVE VARIANCE = 0.28
NEGATIVE STANDARD DEVIATION = 0.31
POSITIVE STANDARD DEVIATION = 0.53



K-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=5.00E+00 UNITS INCH.

DISTRIBUTION RUN11 ROLL05 PITCH15

COURSE 334 E&M DIR. 140 DIST 5.05

VARIATIONS RUN11 ROLL05 PITCH15
COURSE 334 E&M DIR. 148 DIST 5.85

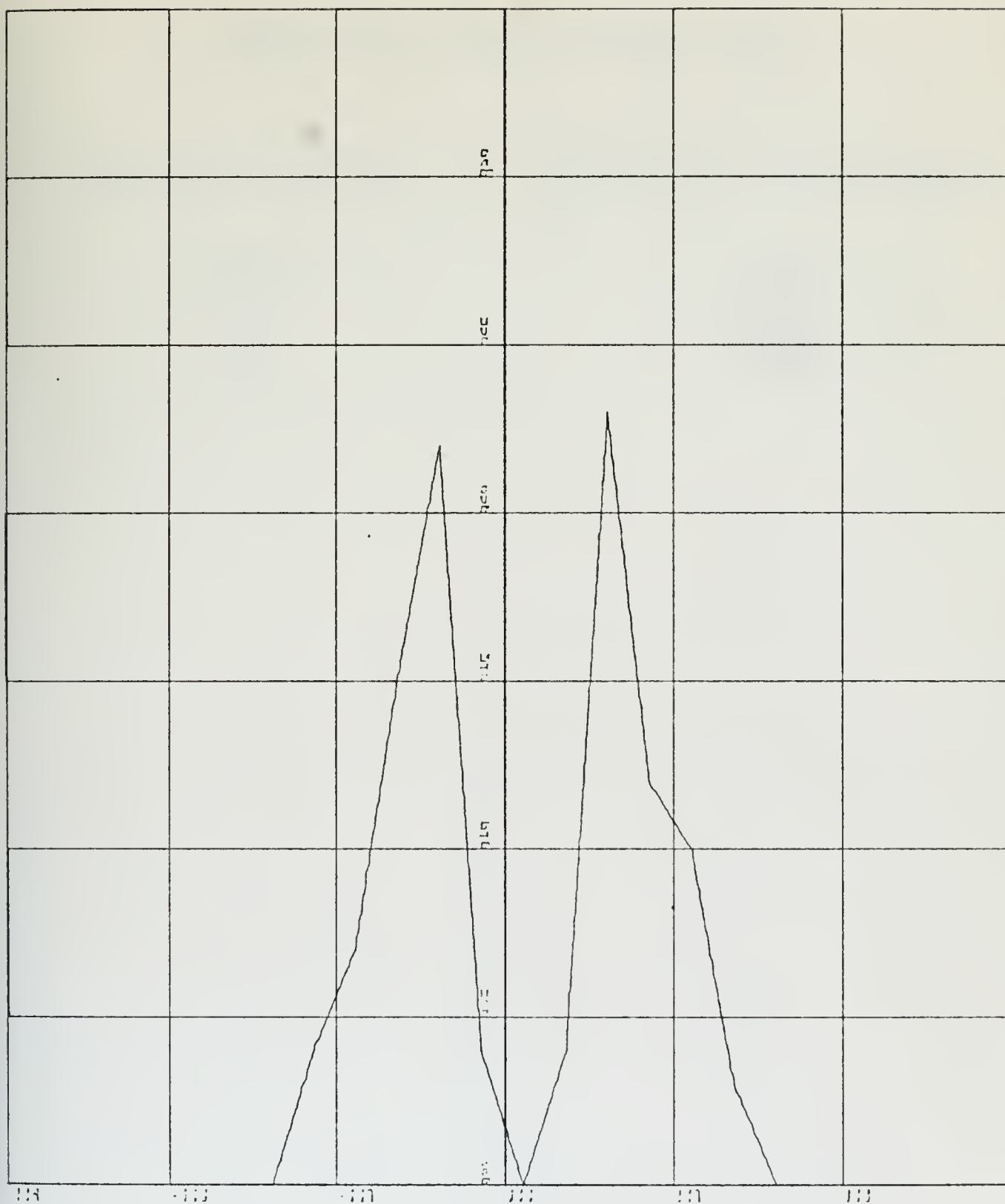
VARIATIONS									
-1.0	2.0	-1.5	2.0	-2.5	2.0	-2.0	2.5	-2.5	1.5
-1.5	2.0	-2.0	1.0	-1.0	1.0	-1.5	1.0	-0.5	0.5
-1.5	2.0	-1.0	1.5	-1.5	1.5	-1.5	1.0	-1.0	1.5
-1.5	1.0	-1.0	2.0	-2.0	2.5	-2.0	1.5	-1.0	1.0
-1.0	1.0	-0.5	1.5	-2.5	1.0	-1.0	1.0	-1.0	1.0
-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.5	1.5	-1.5	2.0
-2.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.0
-1.0	1.0	-1.5	1.5	-1.0	1.0	-1.0	0.5	-0.5	1.5
-1.5	1.5	-1.0	2.0	-2.5	2.5	-2.0	1.0	-1.5	2.0
-2.0	1.0	-1.0	2.0	-1.5	1.5	-1.5	1.0	-1.5	1.5
-0.5	0.5	-1.0	0.5						

AVE. VARIATION = -0.0DB STANDARD DEVIATION = 2.1

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-3.25	0.0
-2.75	0.0
-2.25	4.0
-1.75	7.0
-1.25	15.0
-0.75	22.0
-0.25	4.0
0.25	0.0
0.75	4.0
1.25	23.0
1.75	12.0
2.25	10.0
2.75	3.0
3.25	0.0

NEGATIVE VALUES MEAN	=	-1.36
POSITIVE VALUES MEAN	=	1.36
NEGATIVE VARIANCE	=	0.28
POSITIVE VARIANCE	=	0.28
NEGATIVE STANDARD DEVIATION	=	0.53
POSITIVE STANDARD DEVIATION	=	0.53



K-SCALE=2.00E+00 UNITS INCH.

V-SCALE=5.00E+00 UNITS INCH.

VARIATIONS RUN11 ROLL05 PITCH15

COURSE 334 E&M DIR. 140 DIST 5.85

VARIATIONS RUN11 ROLL05 PITCH15
COURSE 334 E&M DIR. 148 DIST 5.85

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

3.00
2.50
2.00
1.50
1.00
0.50

1.000
0.971
0.837
0.654
0.288
0.038

ANTENNA SIMULATION

LENGTH OF ANTENNA = .95 METERS
 HEIGHT OF ANTENNA = 18.2 METERS
 PHI OF ANTENNA = 000 DEGREES RELATIVE
 THETA OF ANTENNA = 000 DEGREES RELATIVE
 FREQUENCY = 149.0 MHZ
 EPSILON = 80.0
 SIGMA = 5.0
 PHI OF PL0T = 184 DEGREES RELATIVE
 THETA OF PL0T = 089 DEGREES RELATIVE
 SEA STATE = 5
 DIRECTION OF SEA = 007 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
-------------------	--------------------	-------------------------

.8	2.6	4.967
1.7	5.2	1.477
2.4	7.5	1.364
3.1	9.7	2.547
3.7	11.6	3.224
4.2	13.1	2.913
4.6	14.2	2.408
4.8	14.9	2.101
4.9	15.1	2.008
4.8	14.9	2.101
4.6	14.2	2.408
4.2	13.1	2.913
3.7	11.6	3.224
3.1	9.7	2.547
2.4	7.5	1.364
1.7	5.2	1.477
.8	2.6	4.967
-.8	-2.6	5.168
-1.7	-5.2	1.618
-2.4	-7.5	1.298
-3.1	-9.7	2.320
-3.7	-11.6	3.122
-4.2	-13.1	3.043
-4.6	-14.2	2.634
-4.8	-14.9	2.337
-4.9	-15.1	2.239
-4.8	-14.9	2.337
-4.6	-14.2	2.634
-4.2	-13.1	3.043
-3.7	-11.6	3.122
-3.1	-9.7	2.320
-2.4	-7.5	1.298
-1.7	-5.2	1.618
-.8	-2.6	5.168

AVERAGE VALUE = 2.63 DB

DISTRIBUTION RUN11AROLL05 PITCH15
COURSE 334 E&M DIR. 150 DIST 6.67

DATA POINTS

76.0	75.5	77.0	75.5	76.0	74.5	77.5	75.0	77.5
76.5	77.5	75.0	76.5	75.5	77.5	76.0	77.0	75.5
77.0	76.0	77.0	76.0	78.0	76.0	77.5	76.5	77.0
76.5	79.0	76.0	77.0	76.5	77.0	76.0	78.5	77.0
78.0	76.0	78.0	77.5	77.5	76.0	78.0	77.0	79.5
77.5	78.0	76.0	77.0	76.5	78.5	77.0	77.5	76.0
77.0	76.5	79.0	77.5	79.0	76.5	77.5	76.5	78.0
77.0	78.0	76.0	78.0	77.0	78.5	76.5	78.5	77.0
78.0	76.0							

AVERAGE POWER = 77.0DB STANDARD DEVIATION = 1.1

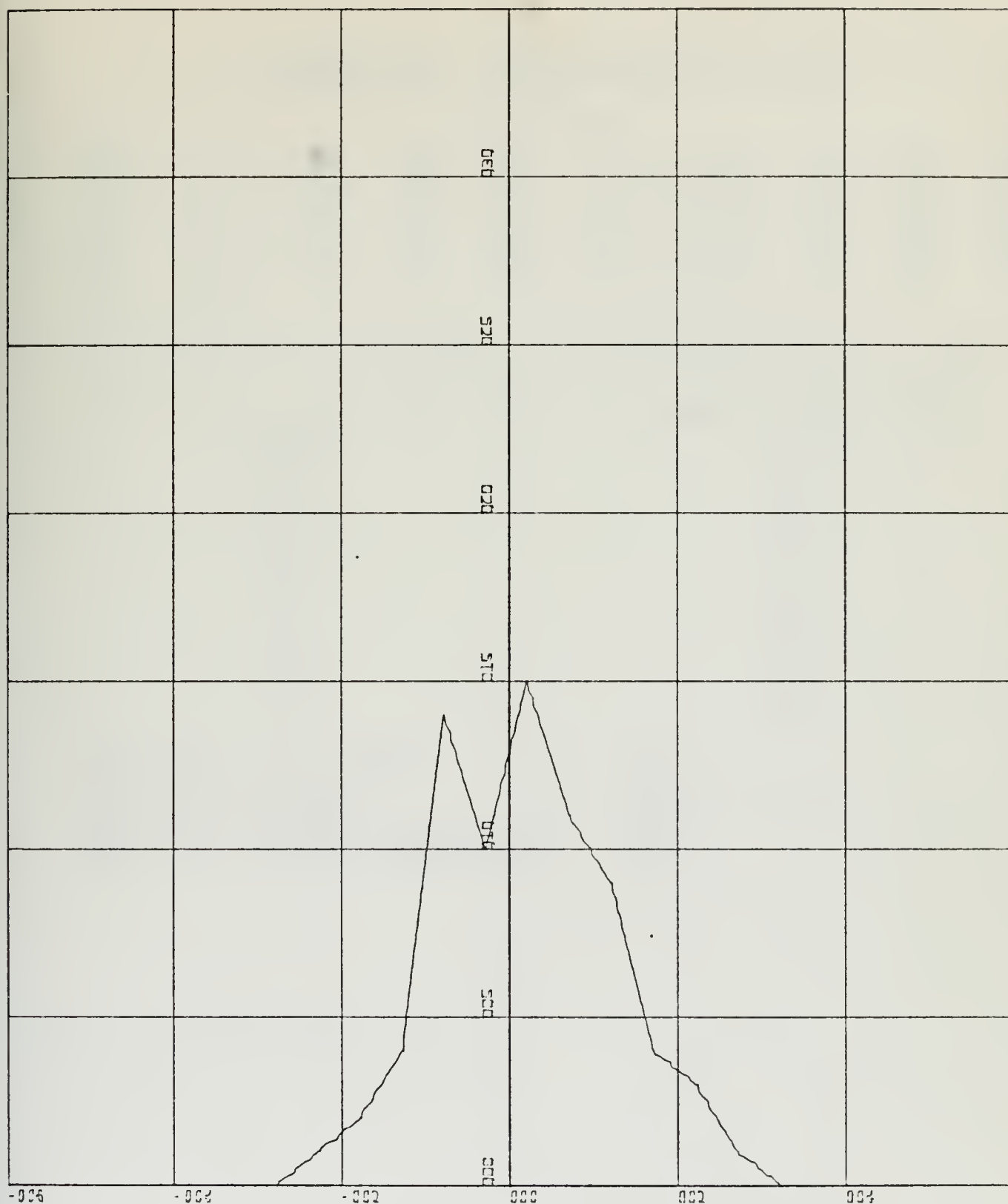
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-3.25	0.0
-2.75	0.0
-2.25	1.0
-1.75	2.0
-1.25	4.0
-0.75	14.0
-0.25	10.0
0.25	15.0
0.75	11.0
1.25	9.0
1.75	4.0
2.25	3.0
2.75	1.0
3.25	0.0

NEGATIVE VALUES MEAN	=	-0.98
POSITIVE VALUES MEAN	=	0.71
NEGATIVE VARIANCE	=	0.26
POSITIVE VARIANCE	=	0.46
NEGATIVE STANDARD DEVIATION	=	0.51
POSITIVE STANDARD DEVIATION	=	0.68



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=5.00E+00 UNITS INCH.

DISTRIBUTION RUN11AROLLO5 PITCH15
COURSE 334 E&M DIR. 150 DIST 6.67

VARIATIONS RUN11AROLL05 PITCH15
COURSE 334 E&M DIR. 150 DIST 6.67

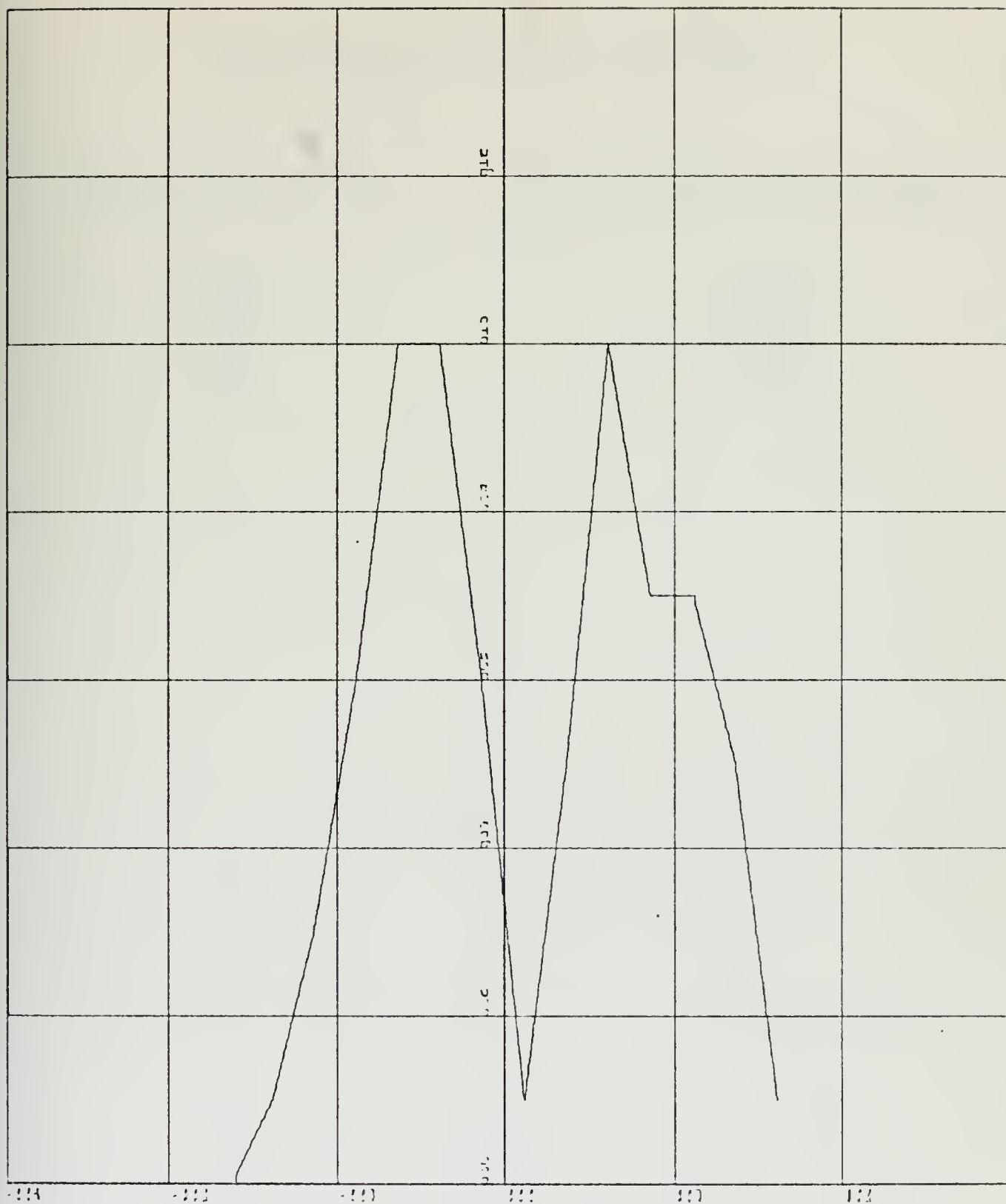
VARIATIONS									
-0.5	1.5	-1.5	0.5	-1.5	3.0	-2.5	2.5	-1.0	1.0
-2.5	1.5	-1.0	2.0	-1.5	1.0	-1.5	1.5	-1.0	1.0
-1.0	2.0	-2.0	1.5	-1.0	0.5	-0.5	2.5	-3.0	1.0
-0.5	0.5	-1.0	2.5	-1.5	1.0	-2.0	2.0	-0.5	0.0
-1.5	2.0	-1.0	2.5	-2.0	0.5	-2.0	1.0	-0.5	2.0
-1.5	0.5	-1.5	1.0	-0.5	2.5	-1.5	1.5	-2.5	1.0
-1.0	1.5	-1.0	1.0	-2.0	2.0	-1.0	1.5	-2.0	2.0
-1.5	1.0								

AVE. VARIATION = 0.0DB STANDARD DEVIATION = 2.5

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-3.25	0.0
-2.75	1.0
-2.25	3.0
-1.75	6.0
-1.25	10.0
-0.75	10.0
-0.25	6.0
0.25	1.0
0.75	5.0
1.25	10.0
1.75	7.0
2.25	7.0
2.75	5.0
3.25	1.0

NEGATIVE VALUES MEAN	=	-1.40
POSITIVE VALUES MEAN	=	1.50
NEGATIVE VARIANCE	=	0.43
POSITIVE VARIANCE	=	0.49
NEGATIVE STANDARD DEVIATION	=	0.65
POSITIVE STANDARD DEVIATION	=	0.70



K-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=2.00E+00 UNITS INCH.

VARIATIONS RUN11AR0LL05 PITCH15

COURSE 334 E&M DIR. 150 DIST 6.67

VARIATIONS RUN11AROLLO5 PITCH15
COURSE 334 E&M DIR. 150 DIST 6.67

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

3.00
2.50
2.00
1.50
1.00
0.50

0.986
0.903
0.764
0.583
0.306
0.097

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLST	=	118 DEGREES RELATIVE
THETA OF PLST	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	000 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
-------------------	--------------------	-------------------------

.0	.9	28.870
.0	1.7	28.875
.0	2.5	28.884
.0	3.2	28.895
.0	3.8	28.906
.0	4.3	28.917
.0	4.7	28.926
.0	4.9	28.931
.0	5.0	28.933
.0	4.9	28.931
.0	4.7	28.926
.0	4.3	28.917
.0	3.8	28.906
.0	3.2	28.895
.0	2.5	28.884
.0	1.7	28.875
.0	.9	28.870
.0	-.9	28.870
.0	-1.7	28.875
.0	-2.5	28.884
.0	-3.2	28.895
.0	-3.8	28.906
.0	-4.3	28.917
.0	-4.7	28.926
.0	-4.9	28.931
.0	-5.0	28.933
.0	-4.9	28.931
.0	-4.7	28.926
.0	-4.3	28.917
.0	-3.8	28.906
.0	-3.2	28.895
.0	-2.5	28.884
.0	-1.7	28.875
.0	-.9	28.870

AVERAGE VALUE = -28.90 DB

DISTRIBUTION RUN12 ROLLOO PITCH05
COURSE 270 E&M DIR. 152 DIST 7.47

DATA POINTS

76.0	78.5	76.0	78.0	76.5	78.5	75.5	79.0	75.5
80.0	76.5	78.5	77.0	79.0	76.0	78.0	77.0	79.0
76.0	81.0	76.5	78.0	76.5	78.0	76.5	77.0	76.5
77.0	76.5	77.0	76.5	78.0	75.0	77.0	76.0	77.0
76.0	77.5	76.5	78.0	76.0	79.0	77.0	77.5	76.0
78.5	76.5	77.0	76.5	77.0	76.0	76.5	76.0	77.0
75.5	77.0	76.0	78.5	76.0	77.0	76.0	77.0	76.0
76.5	76.0	77.0	75.0	77.0	75.0	76.0	75.5	76.0
75.5	77.0	75.0	77.0	75.5	77.0	75.0	76.5	76.0

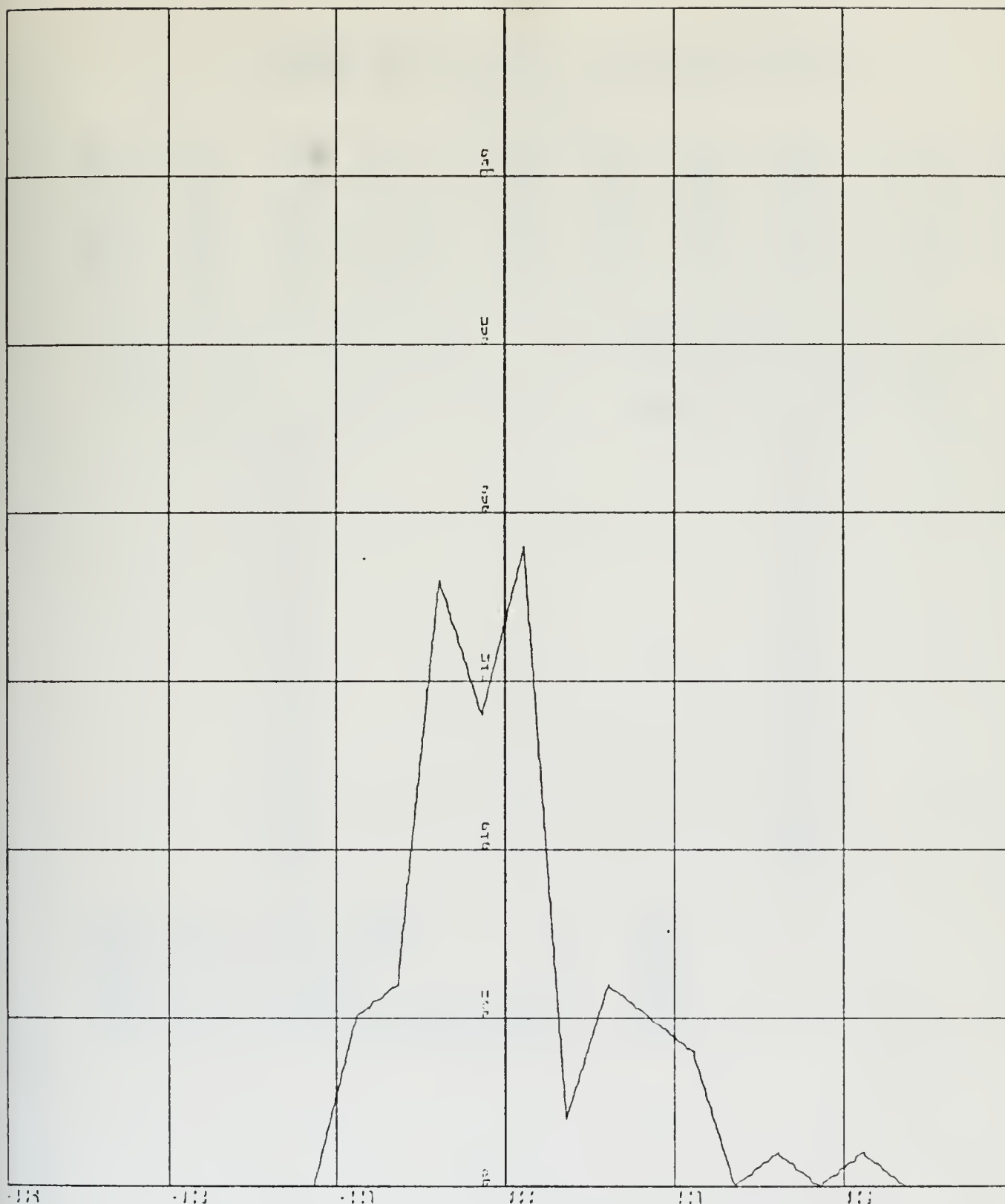
AVERAGE POWER = 76.8DB STANDARD DEVIATION = 1.4

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB POINTS AT THAT POWER

-5.25	0.0
-4.75	0.0
-4.25	0.0
-3.75	0.0
-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	5.0
-1.25	6.0
-0.75	18.0
-0.25	14.0
0.25	19.0
0.75	2.0
1.25	6.0
1.75	5.0
2.25	4.0
2.75	0.0
3.25	1.0
3.75	0.0
4.25	1.0
4.75	0.0
5.25	0.0

NEGATIVE VALUES MEAN = -0.84
POSITIVE VALUES MEAN = 0.96
NEGATIVE VARIANCE = 0.24
POSITIVE VARIANCE = 0.97
NEGATIVE STANDARD DEVIATION = 0.49
POSITIVE STANDARD DEVIATION = 0.98



K-SCALE=2.00E+00 UNITS INCH.

V-SCALE=5.00E+00 UNITS INCH.

DISTRIBUTION RUN12 ROLL00 PITCH05

COURSE 270 E&M DIR. 152 DIST 7.47

VARIATIONS RUN12 ROLLOO PITCH05
 COURSE 270 E&M DIR. 152 DIST 7.47

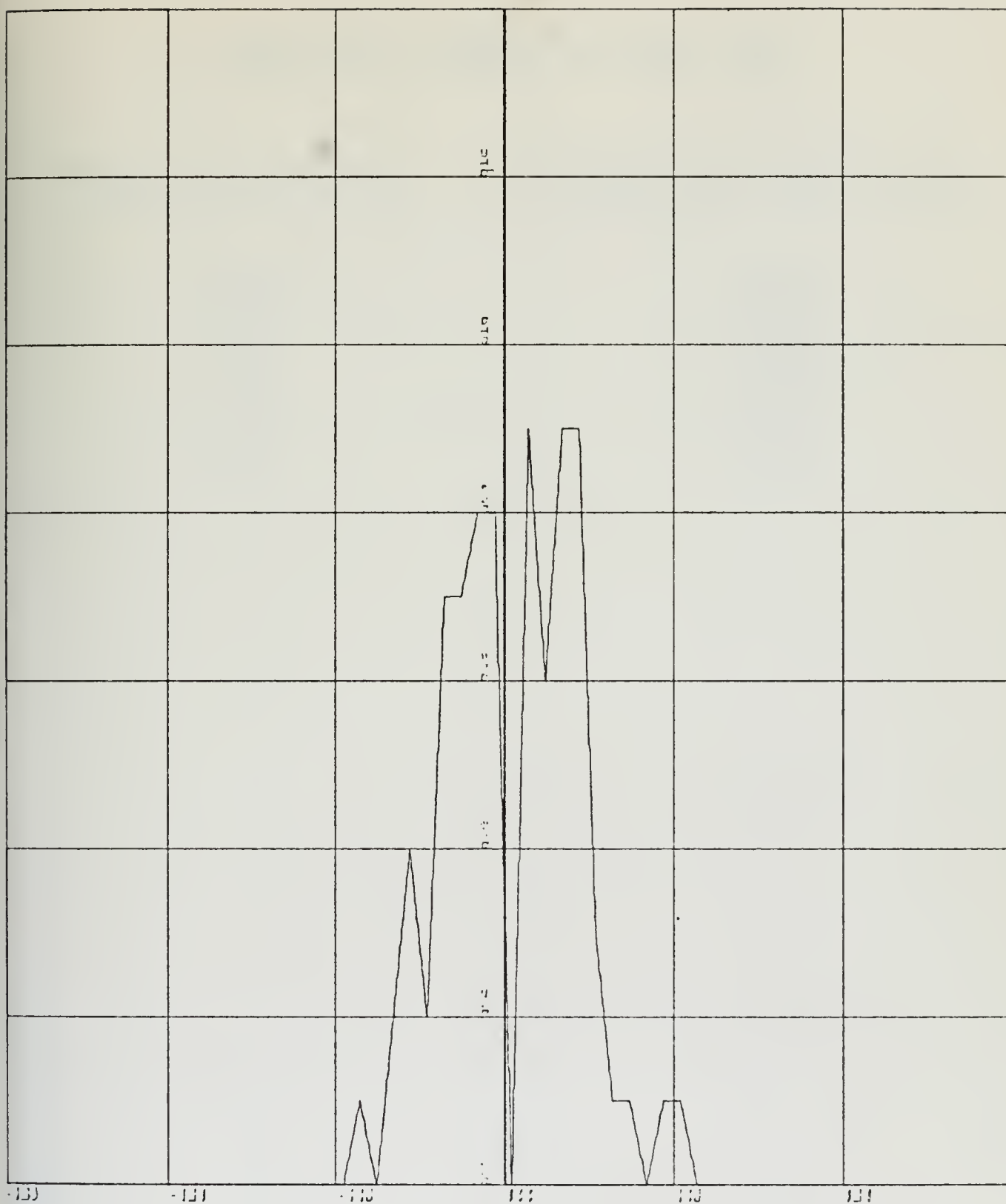
VARIATIONS							
2.5	-2.5	2.0	-1.5	2.0	-3.0	3.5	-3.5
2.0	-1.5	2.0	-3.0	2.0	-1.0	2.0	-3.0
1.5	-1.5	1.5	-1.5	0.5	-0.5	0.5	-0.5
1.5	-3.0	2.0	-1.0	1.0	-1.0	1.5	-1.0
3.0	-2.0	0.5	-1.5	2.5	-2.0	0.5	-0.5
0.5	-0.5	1.0	-1.5	1.5	-1.0	2.5	-2.5
1.0	-1.0	0.5	-0.5	1.0	-2.0	2.0	-2.0
0.5	-0.5	1.5	-2.0	2.0	-1.5	1.5	-2.0
							1.5

AVE. VARIATION = 0.0DB STANDARD DEVIATION = 3.8

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-5.25	0.0
-4.75	0.0
-4.25	1.0
-3.75	0.0
-3.25	2.0
-2.75	4.0
-2.25	2.0
-1.75	7.0
-1.25	7.0
-0.75	8.0
-0.25	8.0
0.25	0.0
0.75	9.0
1.25	6.0
1.75	9.0
2.25	9.0
2.75	3.0
3.25	1.0
3.75	1.0
4.25	0.0
4.75	1.0
5.25	1.0

NEGATIVE VALUES MEAN	=	-1.67
POSITIVE VALUES MEAN	=	1.64
NEGATIVE VARIANCE	=	1.02
POSITIVE VARIANCE	=	1.09
NEGATIVE STANDARD DEVIATION	=	1.01
POSITIVE STANDARD DEVIATION	=	1.04



K-SCALE=5.00E+00 UNITS INCH.
 Y-SCALE=2.00E+00 UNITS INCH.
 VARIATIONS RUN12 ROLL00 PITCH05
 COURSE 270 E&M DIR. 152 DIST 7.47

VARIATIONS RUN12 ROLLOO PITCH05
COURSE 270 E&M DIR. 152 DIST 7.47

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

5.00	0.987
4.50	0.975
4.00	0.962
3.50	0.949
3.00	0.911
2.50	0.823
2.00	0.684
1.50	0.481
1.00	0.316
0.50	0.101

ANTENNA SIMULATION

LENGTH OF ANTENNA = .95 METERS
 HEIGHT OF ANTENNA = 18.2 METERS
 PHI OF ANTENNA = 000 DEGREES RELATIVE
 THETA OF ANTENNA = 000 DEGREES RELATIVE
 FREQUENCY = 149.0 MHZ
 EPSILON = 80.0
 SIGMA = 5.0
 PHI OF PL0T = 208 DEGREES RELATIVE
 THETA OF PL0T = 089 DEGREES RELATIVE
 SEA STATE = 2
 DIRECTION OF SEA = 026 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
1.2	.9	2.800
2.4	1.7	1.404
3.5	2.5	3.285
4.5	3.2	2.548
5.4	3.8	1.852
6.1	4.3	2.269
6.6	4.7	2.743
6.9	4.9	2.880
7.0	5.0	2.884
6.9	4.9	2.880
6.6	4.7	2.743
6.1	4.3	2.269
5.4	3.8	1.852
4.5	3.2	2.548
3.5	2.5	3.285
2.4	1.7	1.404
1.2	.9	2.800
-1.2	-.9	3.005
-2.4	-1.7	1.349
-3.5	-2.5	3.127
-4.5	-3.2	2.783
-5.4	-3.8	1.912
-6.1	-4.3	2.094
-6.6	-4.7	2.551
-6.9	-4.9	2.784
-7.0	-5.0	2.834
-6.9	-4.9	2.784
-6.6	-4.7	2.551
-6.1	-4.3	2.094
-5.4	-3.8	1.912
-4.5	-3.2	2.783
-3.5	-2.5	3.127
-2.4	-1.7	1.349
-1.2	-.9	3.005

AVERAGE VALUE = 2.48 DB

DISTRIBUTION RUN13 ROLL07 PITCH05
COURSE 000 E&M DIR. 152 DIST 7.47

DATA POINTS

77.0	76.0	77.0	75.5	77.0	75.5	77.0	76.0	77.0
76.0	77.5	76.0	77.0	76.5	77.0	76.5	77.0	75.5
77.5	75.0	78.0	76.0	77.0	76.0	77.0	76.0	77.5
77.0	79.0	76.5	78.5	77.0	78.0	77.0	77.5	76.5
79.0	76.0	78.0	76.5	79.0	76.0	81.0	77.5	79.0
77.5	79.0	77.0	78.5	77.0	78.0	76.0	79.5	77.0
79.5	77.0	79.0	77.0	80.0	77.5	80.5	77.5	80.5
77.5	80.0	79.0	81.5	78.0	79.5	79.0	81.0	78.5
81.0	79.0	80.5	77.5	80.0	77.5	81.5	77.0	79.0
77.5	81.0	76.5	81.0	78.0	81.0	78.0	81.0	78.5
81.0	77.0	80.0	77.5	82.0	77.5	82.0	77.5	

AVERAGE POWER = 78.0DB STANDARD DEVIATION = 2.9

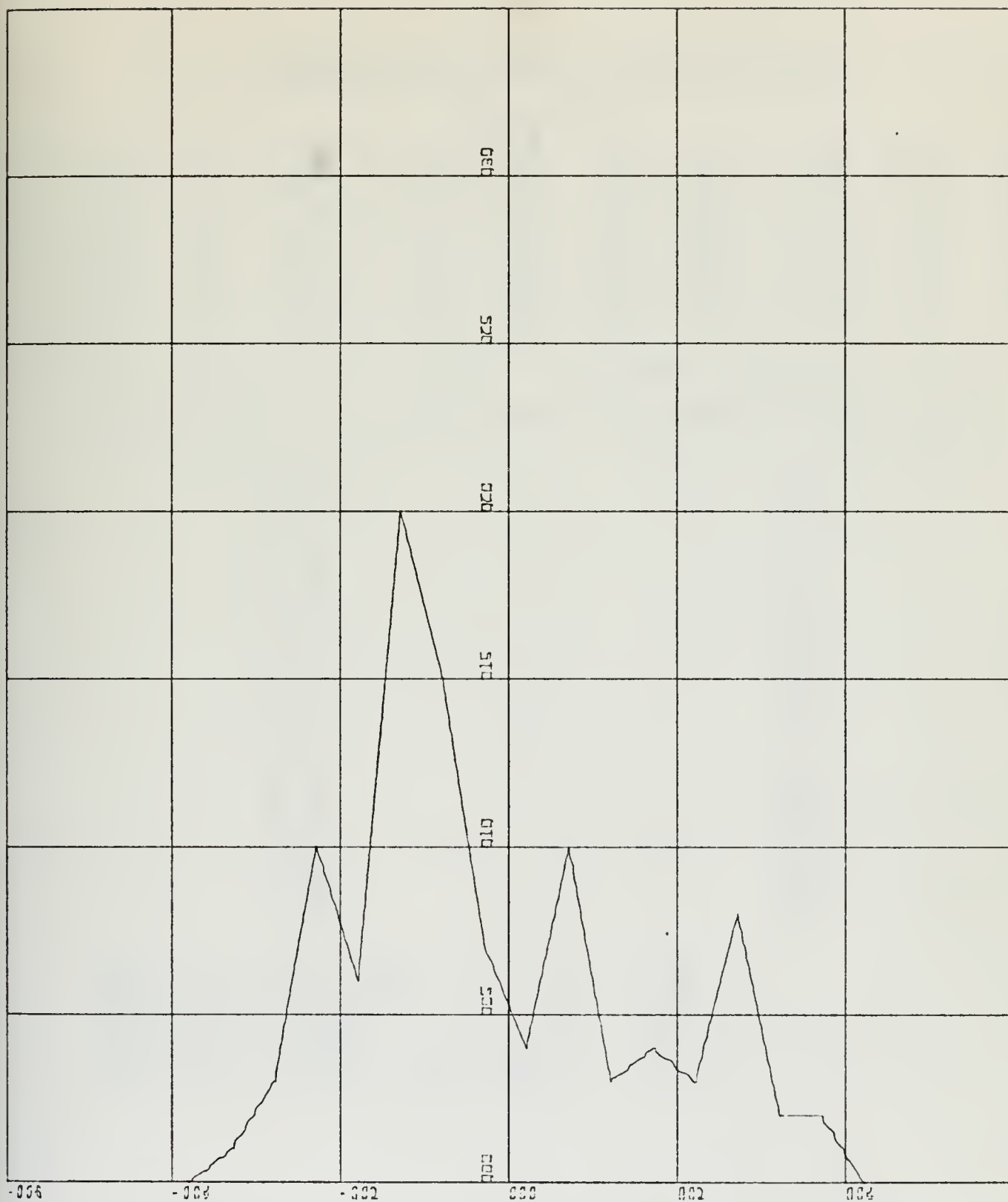
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-4.25	0.0
-3.75	0.0
-3.25	1.0
-2.75	3.0
-2.25	10.0
-1.75	6.0
-1.25	20.0
-0.75	15.0
-0.25	7.0
0.25	4.0
0.75	10.0
1.25	3.0
1.75	4.0
2.25	3.0
2.75	8.0
3.25	2.0
3.75	2.0
4.25	0.0

NEGATIVE VALUES MEAN	=	-1.12
POSITIVE VALUES MEAN	=	1.93
NEGATIVE VARIANCE	=	0.53
POSITIVE VARIANCE	=	1.17
NEGATIVE STANDARD DEVIATION	=	0.73
POSITIVE STANDARD DEVIATION	=	1.08



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=5.00E+00 UNITS INCH.

DISTRIBUTION RUN13 ROLLO7 PITCH05

COURSE 000 E&M DIR. 152 DIST 7.47

VARIATIONS RUN13 ROLL07 PITCH05
 COURSE 000 E&M DIR. 152 DIST 7.47

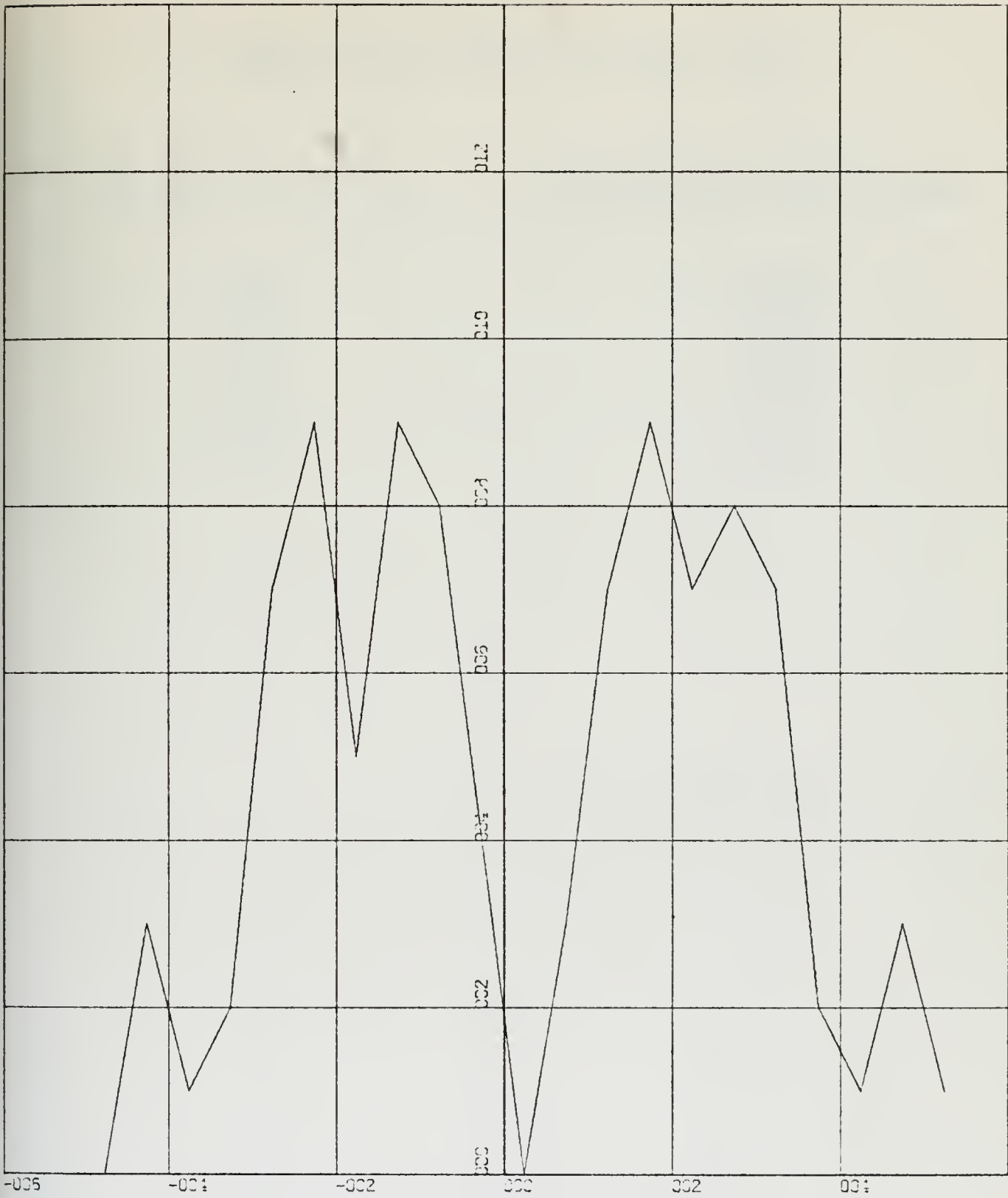
VARIATIONS									
-1.0	1.0	-1.5	1.5	-1.5	1.5	-1.0	1.0	-1.0	1.5
-1.5	1.0	-0.5	0.5	-0.5	0.5	-1.5	2.0	-2.5	3.0
-2.0	1.0	-1.0	1.0	-1.0	1.5	-0.5	2.0	-2.5	2.0
-1.5	1.0	-1.0	0.5	-1.0	2.5	-3.0	2.0	-1.5	2.5
-3.0	5.0	-3.5	1.5	-1.5	1.5	-2.0	1.5	-1.5	1.0
-2.0	3.5	-2.5	2.5	-2.5	2.0	-2.0	3.0	-2.5	3.0
-3.0	3.0	-3.0	2.5	-1.0	2.5	-3.5	1.5	-0.5	2.0
-2.5	2.5	-2.0	1.5	-3.0	2.5	-2.5	4.0	-4.5	2.0
-1.5	3.5	-4.5	4.5	-3.0	3.0	-3.0	3.0	-2.5	2.5
-4.0	3.0	-2.5	4.5	-4.5	4.5				

AVE. VARIATION = 0.1DB STANDARD DEVIATION = 5.9

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-5.25	0.0
-4.75	0.0
-4.25	3.0
-3.75	1.0
-3.25	2.0
-2.75	7.0
-2.25	9.0
-1.75	5.0
-1.25	9.0
-0.75	8.0
-0.25	4.0
0.25	0.0
0.75	3.0
1.25	7.0
1.75	9.0
2.25	7.0
2.75	8.0
3.25	7.0
3.75	2.0
4.25	1.0
4.75	3.0
5.25	1.0

NEGATIVE VALUES MEAN	=	-2.11
POSITIVE VALUES MEAN	=	2.22
NEGATIVE VARIANCE	=	1.17
POSITIVE VARIANCE	=	1.25
NEGATIVE STANDARD DEVIATION	=	1.08
POSITIVE STANDARD DEVIATION	=	1.12



X-SCALE:-2.00E+00 UNITS INCH.
Y-SCALE:-2.00E+00 UNITS INCH.
VARIATIONS RUN13 ROLLO7 PITCH05
COURSE 000 E&M DIR. 152 DIST 7.47

VARIATIONS RUN13 ROLL07 PITCH05
COURSE 000 E&M DIR. 152 DIST 7.47

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

5.00	0.990
4.50	0.958
4.00	0.917
3.50	0.885
3.00	0.792
2.50	0.635
2.00	0.469
1.50	0.323
1.00	0.156
0.50	0.042

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PL0T	=	121 DEGREES RELATIVE
THETA OF PL0T	=	089 DEGREES RELATIVE
SEA STATE	=	4
DIRECTION OF SEA	=	000 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
.0	1.7	28.876
.0	3.4	28.899
.0	5.0	28.934
.0	6.4	28.977
.0	7.7	29.024
.0	8.7	29.067
.0	9.4	29.103
.0	9.9	29.126
.0	10.0	29.134
.0	9.9	29.126
.0	9.4	29.103
.0	8.7	29.067
.0	7.7	29.024
.0	6.4	28.977
.0	5.0	28.934
.0	3.4	28.899
.0	1.7	28.876
.0	-1.7	28.876
.0	-3.4	28.899
.0	-5.0	28.934
.0	-6.4	28.977
.0	-7.7	29.024
.0	-8.7	29.067
.0	-9.4	29.103
.0	-9.9	29.126
.0	-10.0	29.134
.0	-9.9	29.126
.0	-9.4	29.103
.0	-8.7	29.067
.0	-7.7	29.024
.0	-6.4	28.977
.0	-5.0	28.934
.0	-3.4	28.899
.0	-1.7	28.876

AVERAGE VALUE = -29.01 DB

DISTRIBUTION RUN19 ROLL00 PITCH10
COURSE 270 E&M DIR. 149 DIST 10.49

DATA POINTS

81.5	83.0	82.0	83.0	82.0	83.0	82.5	84.0	81.0
82.5	81.5	84.0	83.0	83.5	81.5	84.0	81.5	83.0
82.5	84.5	82.5	84.0	83.0	85.0	80.5	83.0	82.5
83.0	82.0	83.5	82.5	83.0	81.0	83.5	83.0	83.5
83.0	84.5	82.0	83.0	81.5	86.0	82.5	83.0	82.0
82.5	81.0	84.0	82.5	85.5	83.0	84.5	83.0	83.5
82.5	83.5	82.0	84.0	82.5	85.0	81.5	83.5	82.5
84.0	82.5	84.0	82.5	83.0	82.5	83.0	82.0	83.0
82.0	83.5	80.5	82.0	81.0	84.0	82.5	85.0	83.0
84.5	81.5	83.0	82.0	86.5	81.0	82.5	81.5	84.0
82.0	85.0	81.5	82.5	81.5	84.0	82.0	84.5	83.0
85.5	84.0	85.0	82.0	84.5	83.0	85.0	84.0	85.5
82.5	85.5	83.0	84.0	82.5	85.0	82.5	85.5	83.0
86.5	82.0	83.5	81.5	84.0	82.0	84.5	83.0	85.5
84.0	85.0	82.0	84.5	83.0	85.0	84.0	85.5	82.5
85.5	83.0	84.0	82.5	85.0	82.5	85.5	83.0	86.5
82.0	83.5	82.5	85.5	82.5	87.0	84.5	87.5	84.0
85.0	83.0	84.0	82.0	84.0	83.0	84.0	83.0	84.0
83.0	84.0	82.0	83.0	82.0	87.0	83.0	85.5	80.5
87.0	82.5	83.0	81.5	83.5	82.5	86.0	82.0	83.0
82.0	83.0	82.0	85.5	84.0	86.0	83.0	84.0	81.5
82.5	81.5	85.0	82.5	84.0	82.5	85.0	83.5	84.0
82.0	83.5	80.0	87.0	83.5	86.0	82.0	83.0	

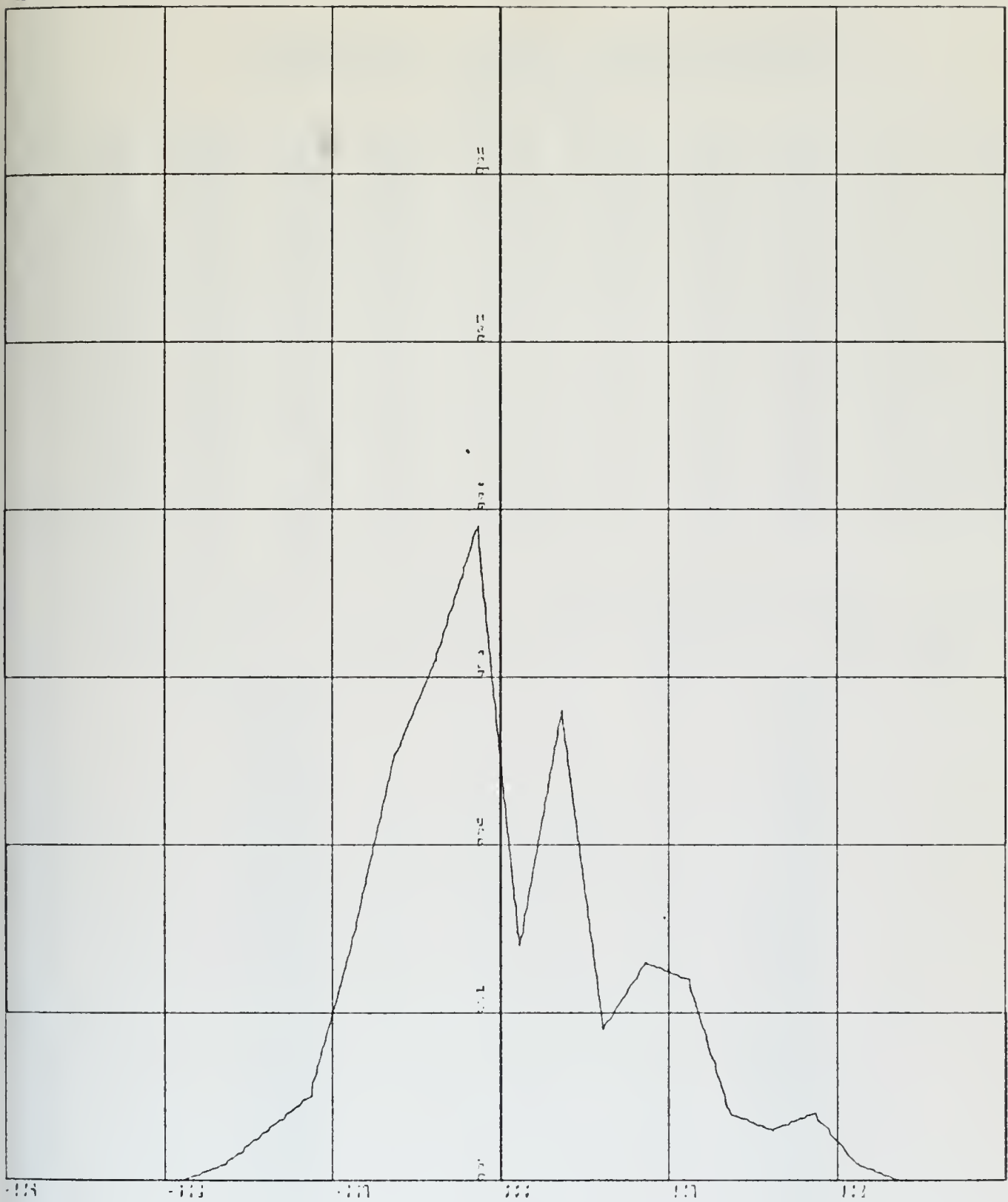
AVERAGE POWER = 83.3DB STANDARD DEVIATION = 2.1

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB POINTS AT THAT POWER

-5.25	0.0
-4.75	0.0
-4.25	0.0
-3.75	0.0
-3.25	1.0
-2.75	3.0
-2.25	5.0
-1.75	14.0
-1.25	25.0
-0.75	31.0
-0.25	39.0
0.25	14.0
0.75	28.0
1.25	9.0
1.75	13.0
2.25	12.0
2.75	4.0
3.25	3.0
3.75	4.0
4.25	1.0
4.75	0.0
5.25	0.0

NEGATIVE VALUES MEAN = -1.01
 POSITIVE VALUES MEAN = 1.36
 NEGATIVE VARIANCE = 0.47
 POSITIVE VARIANCE = 1.02
 NEGATIVE STANDARD DEVIATION = 0.69
 POSITIVE STANDARD DEVIATION = 1.01



K-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=1.00E+01 UNITS INCH.

DISTRIBUTION RUN19 ROLL00 PITCH10

COURSE 270 E&M DIR. 149 DIST 10.49

VARIATIONS RUN19 ROLLOO PITCH10
COURSE 270 E&M DIR. 149 DIST 10.49

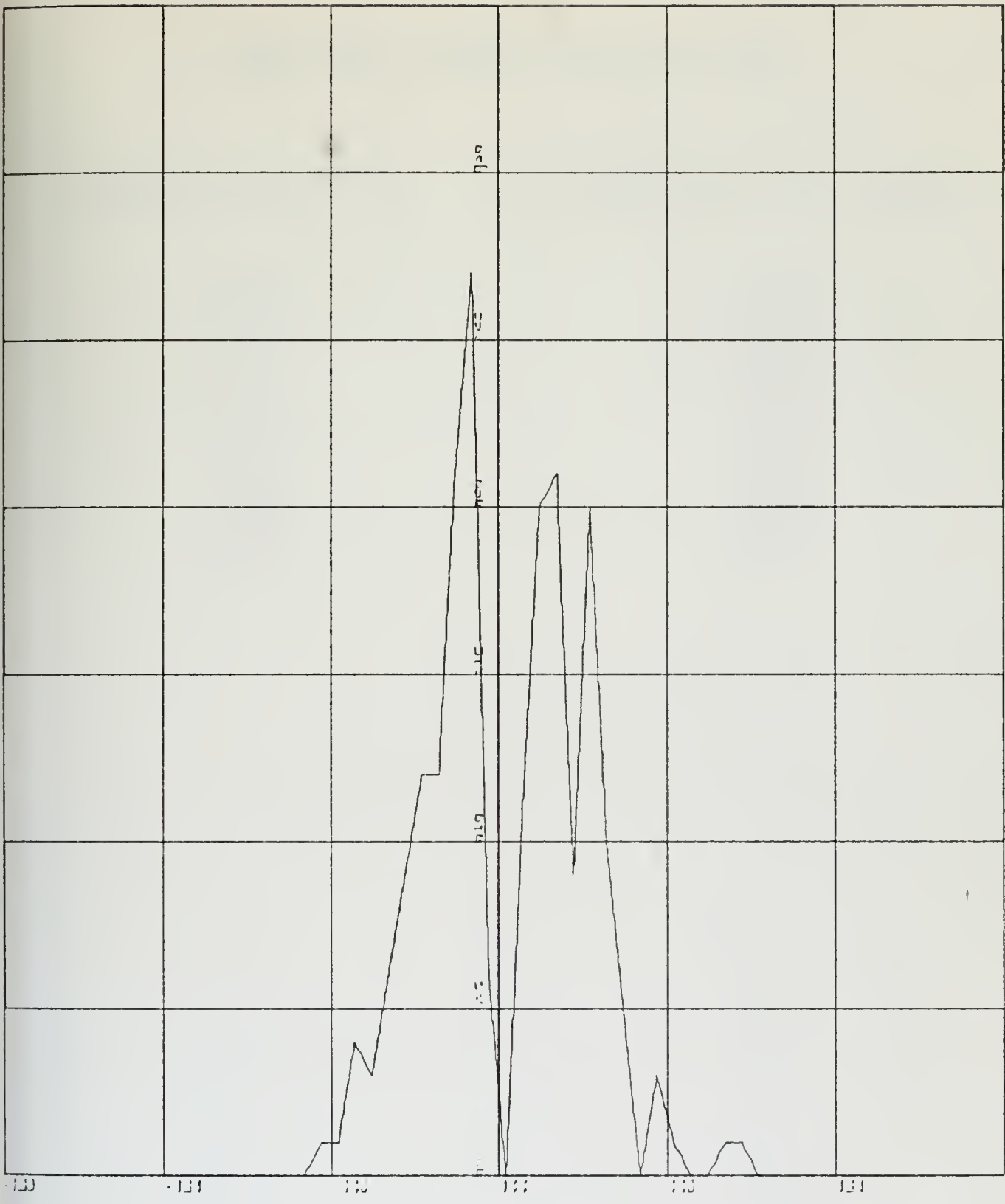
VARIATIONS				VARIATIONS				VARIATIONS			
1.5	-1.0	1.0	-1.0	1.0	-0.5	1.5	-3.0	1.5	-1.0		
2.5	-1.0	0.5	-2.0	2.5	-2.5	1.5	-0.5	2.0	-2.0		
1.5	-1.0	2.0	-4.5	2.5	-0.5	0.5	-1.0	1.5	-1.0		
0.5	-2.0	2.5	-0.5	0.5	-0.5	1.5	-2.5	1.0	-1.5		
4.5	-3.5	0.5	-1.0	0.5	-1.5	3.0	-1.5	3.0	-2.5		
1.5	-1.5	0.5	-1.0	1.0	-1.5	2.0	-1.5	2.5	-3.5		
2.0	-1.0	1.5	-1.5	1.5	-1.5	0.5	-0.5	0.5	-1.0		
1.0	-1.0	1.5	-3.0	1.5	-1.0	3.0	-1.5	2.5	-2.0		
1.5	-3.0	1.5	-1.0	4.5	-5.5	1.5	-1.0	2.5	-2.0		
3.0	-3.5	1.0	-1.0	2.5	-2.0	2.5	-1.5	2.5	-1.5		
1.0	-3.0	2.5	-1.5	2.0	-1.0	1.5	-3.0	3.0	-2.5		
1.0	-1.5	2.5	-2.5	3.0	-2.5	3.5	-4.5	1.5	-2.0		
2.5	-2.0	2.5	-1.5	2.5	-1.5	1.0	-3.0	2.5	-1.5		
2.0	-1.0	1.5	-3.0	3.0	-2.5	1.0	-1.5	2.5	-2.5		
3.0	-2.5	3.5	-4.5	1.5	-1.0	3.0	-3.0	4.5	-2.5		
3.0	-3.5	1.0	-2.0	1.0	-2.0	2.0	-1.0	1.0	-1.0		
1.0	-1.0	1.0	-2.0	1.0	-1.0	5.0	-4.0	2.5	-5.0		
6.5	-4.5	0.5	-1.5	2.0	-1.0	3.5	-4.0	1.0	-1.0		
1.0	-1.0	3.5	-1.5	2.0	-3.0	1.0	-2.5	1.0	-1.0		
3.5	-2.5	1.5	-1.5	2.5	-1.5	0.5	-2.0	1.5	-3.5		
7.0	-3.5	2.5	-4.0								

AVE. VARIATION = 0.0DB STANDARD DEVIATION = 5.4

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-7.25	0.0
-6.75	0.0
-6.25	0.0
-5.75	0.0
-5.25	1.0
-4.75	1.0
-4.25	4.0
-3.75	3.0
-3.25	6.0
-2.75	9.0
-2.25	12.0
-1.75	12.0
-1.25	21.0
-0.75	27.0
-0.25	6.0
0.25	0.0
0.75	11.0
1.25	20.0
1.75	21.0
2.25	9.0
2.75	20.0
3.25	10.0
3.75	5.0
4.25	0.0
4.75	3.0
5.25	1.0
5.75	0.0
6.25	0.0
6.75	1.0
7.25	1.0

NEGATIVE VALUES MEAN	=	-2.00
POSITIVE VALUES MEAN	=	2.00
NEGATIVE VARIANCE	=	1.28
POSITIVE VARIANCE	=	1.48
NEGATIVE STANDARD DEVIATION	=	1.13
POSITIVE STANDARD DEVIATION	=	1.22



K-SCALE=5.00E+00 UNITS INCH.
K-SCALE=5.00E+00 UNITS INCH.
VARIATIONS RUN19 ROLL00 PITCH10
COURSE 270 E&M DIR. 149 DIST 10.49

VARIATIONS RUN19 ROLLOO PITCH10
COURSE 270 E&M DIR. 149 DIST 10.49

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

7.00	0.995
6.50	0.990
6.00	0.990
5.50	0.990
5.00	0.980
4.50	0.961
4.00	0.941
3.50	0.902
3.00	0.824
2.50	0.681
2.00	0.578
1.50	0.417
1.00	0.216
0.50	0.029

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PL0T	=	211 DEGREES RELATIVE
THETA OF PL0T	=	089 DEGREES RELATIVE
SEA STATE	=	1
DIRECTION OF SEA	=	049 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
1.0	.0	3.638
2.1	.0	1.192
3.0	.0	2.514
3.9	.0	3.337
4.6	.0	2.384
5.2	.0	1.878
5.7	.0	1.967
5.9	.0	2.179
6.0	.0	2.267
5.9	.0	2.179
5.7	.0	1.967
5.2	.0	1.878
4.6	.0	2.384
3.9	.0	3.337
3.0	.0	2.514
2.1	.0	1.192
1.0	.0	3.638
-1.0	.0	3.850
-2.1	.0	1.237
-3.0	.0	2.302
-3.9	.0	3.359
-4.6	.0	2.622
-5.2	.0	1.987
-5.7	.0	1.912
-5.9	.0	2.035
-6.0	.0	2.099
-5.9	.0	2.035
-5.7	.0	1.912
-5.2	.0	1.987
-4.6	.0	2.622
-3.9	.0	3.359
-3.0	.0	2.302
-2.1	.0	1.237
-1.0	.0	3.850

AVERAGE VALUE = 2.39 DB

DISTRIBUTION RUN 20 ROLL06 PITCH00
COURSE 000 E&M DIR. 149 DIST 10.49

DATA POINTS

82.0	86.0	85.0	85.5	84.5	85.5	85.0	85.5	81.0
88.0	87.0	88.5	87.5	89.0	88.0	89.0	88.0	89.5
88.0	89.0	88.0	88.5	82.5	86.0	85.5	86.0	85.5
86.5	85.5	86.5	85.5	86.0	85.0	86.5	85.5	86.0
85.5	86.5	85.0	86.5	85.5	86.5	85.0	85.5	84.5
85.0	84.5	85.0	84.5	86.0	85.0	85.5	85.0	85.5
85.0	85.5	85.0	85.5	85.0	86.0	85.5	86.5	84.5
85.0	84.5	85.0	84.5	87.0	86.5	87.5	85.5	86.5
85.5	86.0	84.5	85.0	84.0	85.0	84.0	85.5	84.5
85.5	84.5	85.5	85.0	85.5	85.0	86.0	85.5	88.0
87.5	89.0	88.0	89.0	88.0	88.5	84.5	85.5	85.0
88.0	87.5	88.0	87.5	88.5	87.5	88.5	87.5	88.0
84.5	85.0	84.0	84.5	84.0	85.0	84.5	86.5	86.0
87.0	86.5	88.0	87.0	88.0	86.5	88.0	86.5	87.5
86.5	87.5	86.0	87.0	86.0	86.5	85.5	86.0	85.0
86.0	85.5	86.0	85.0	86.0	85.0	85.5	84.5	85.5
85.0	85.5	85.0	88.0	87.5	88.5	85.5	88.0	85.0
86.0	85.5	86.5	86.0	86.5	85.5	88.0	87.5	88.5
87.0	88.0	86.5	87.0	86.0	86.5	85.5	86.5	85.5
86.0	85.5	86.5	85.5	87.0	85.5	86.5	85.5	86.5
85.5	86.5	85.5	86.5	85.5	86.5	85.5	87.0	85.5
87.0	85.0	85.5	84.0	85.0	84.5	85.5	85.0	85.5
85.0	86.0	85.0	86.5	85.5	87.0	86.5	87.0	86.5
87.0	85.5	86.5	85.0	85.5	84.5	85.5	85.0	87.0
86.5	87.5	86.0	88.0	87.0	88.0	87.0	88.0	87.0
88.0	86.5	87.5	84.0	85.0	84.0	85.5	84.5	85.5
84.5	86.0	85.5	87.5	87.0	88.0	87.5	88.0	86.5
87.0	86.0	87.0	85.5	86.0	84.5	85.5	84.5	87.5
86.5	87.5	86.5	87.5	86.5	87.0	86.0	86.5	86.0
86.5	85.5	86.5	85.5	86.0	85.5	86.0	85.5	86.0
85.5	87.0	86.5	87.0	85.5	86.0	85.0	85.5	84.5
85.0	84.0	85.0	84.0	85.0	84.5	85.5	85.0	85.5
85.0	85.5	85.0	85.5	85.0	87.0	86.5	88.0	87.0
88.0	86.5	88.0	86.5	88.0	86.5	87.0	85.5	86.0
85.5	86.0	85.0	86.0	84.5	85.5	84.5	85.0	84.5
86.0	85.0	86.5	85.5	87.0	86.5	87.0	86.5	87.0
85.0	85.5	85.0	85.5	85.0	85.5	84.5	85.0	84.5
85.0	84.5	85.0	84.5	85.5	85.0	86.5	86.0	87.0
86.5	88.0	87.5	88.5	88.0	89.0	88.5	90.0	89.0
89.5	88.0	88.5	84.0	85.0	84.5	85.0	83.5	84.0
83.0	83.5	83.0	85.5	85.0	85.5	85.0	86.0	85.5
86.0	85.5	86.5	85.5	86.0	85.5	87.0	85.5	86.0
85.5	86.5	85.0	85.5	84.0	85.5	84.5	85.5	85.0
86.0	85.5	86.5	86.0	87.0	86.5	87.5	87.0	88.0
87.0	88.0	87.5	88.0	87.5	88.5	87.0	87.5	86.0
86.5	86.0	86.5	85.5	86.0	86.0	86.5	86.0	86.5
86.0	86.5	86.0	86.5	85.5	86.5	86.0	87.0	86.5
88.0	87.0	88.0	87.5	88.5	87.0	88.0	86.5	87.5
86.0	86.5	85.5	86.0	85.5	86.0	84.5	85.0	83.5
84.0	83.0	84.0	83.0	84.0	83.5	85.0	84.5	85.0
85.0	86.0	85.0	86.5	86.0	87.0	86.5	88.0	85.5
86.0	85.0	85.5	85.0	85.5	84.0	84.5	85.5	84.5
84.0	85.5	85.0	86.0	85.5	86.0	85.0	85.5	85.5
86.0	85.0	85.5	84.5	85.0	84.5	85.5	85.0	86.5
85.0	85.5	85.0	86.0	85.5	86.0	85.5	87.0	86.5
87.0	86.5	87.0	86.0	86.5	85.5	86.0	84.5	85.0
84.5	85.0	84.5	85.5	84.5	85.5	85.0	85.5	85.0
85.5	85.0	85.5	85.0	85.5	85.0	85.5	85.0	86.0
85.5	86.5	86.0	86.5	85.5	86.0	85.5	86.0	85.5
86.0	85.5	86.5	85.5	86.5	85.5	86.0	86.0	86.5
86.0	86.5	85.5	86.0	85.0	85.5	87.0	84.5	84.0
85.5	85.0	85.5	85.0	85.5	86.5	87.0	85.0	85.5
85.0	86.5	86.0	87.5	87.0	88.0	87.5	88.5	84.5
85.0	84.0	84.5	83.5	84.0	83.5	84.0	83.5	84.0
84.0	85.0	84.5	85.0	84.5	85.0	84.5	85.5	85.5

DISTRIBUTION RUN 20 ROLL06 PITCH00
COURSE 000 E&M DIR. 149 DIST 10.49

DATA POINTS

85.0	86.0	85.5	86.0	85.5	86.0	85.5	86.0	85.5
86.0	85.5	86.5	85.5	86.0	85.5	86.0	85.5	86.5
85.5	86.5	85.5	86.5	85.5	87.0	86.0	87.0	86.0
86.5	85.5	86.0	85.0	85.5	84.5	85.0	84.5	85.0
83.5	84.5	83.5	85.0	84.0	86.5	86.0	87.5	87.0
88.0	87.5	88.0	87.5	88.0	87.5	88.0		

AVERAGE POWER = 85.9DB STANDARD DEVIATION = 1.5

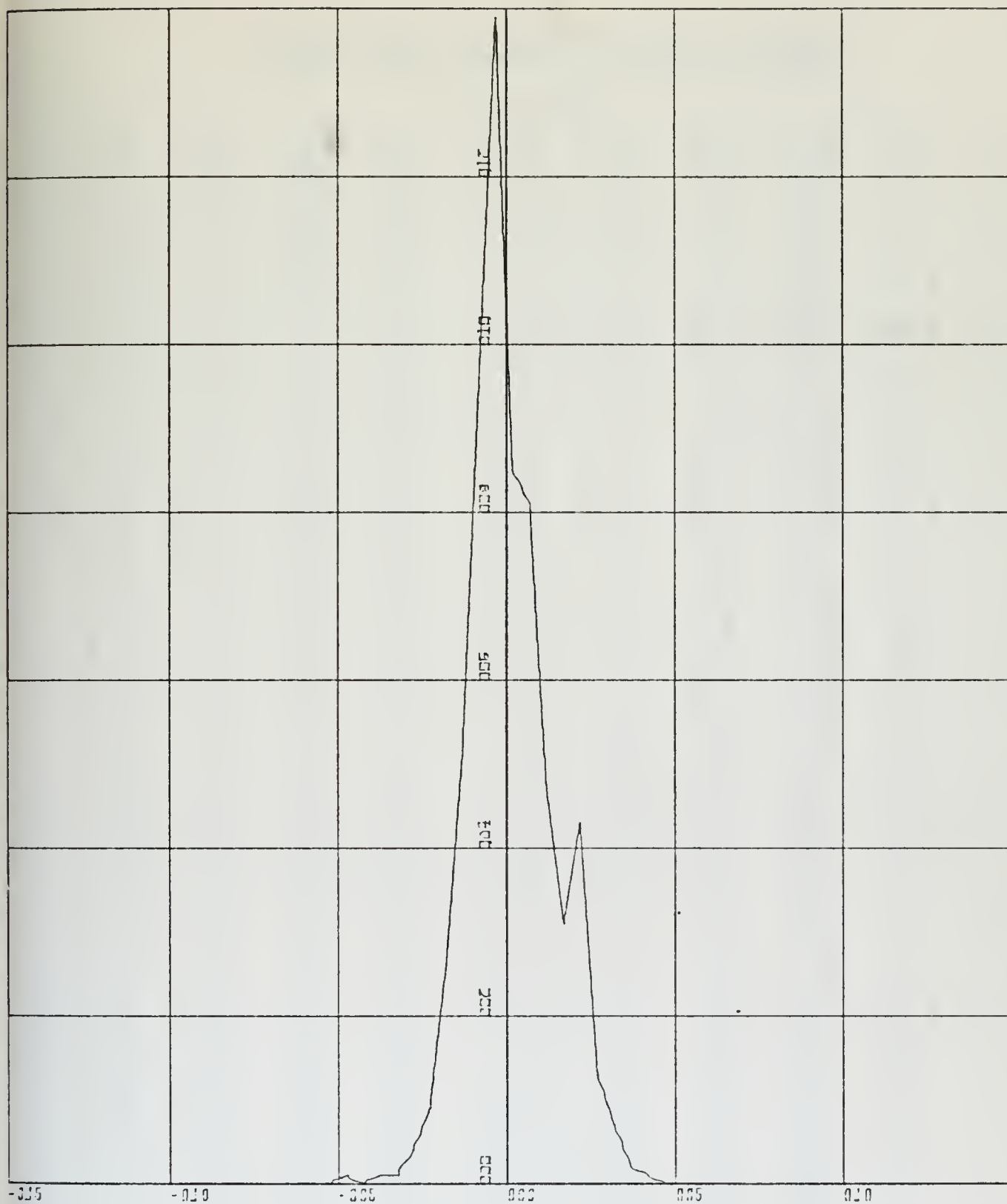
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-5.25	0.0
-4.75	1.0
-4.25	0.0
-3.75	1.0
-3.25	1.0
-2.75	4.0
-2.25	9.0
-1.75	26.0
-1.25	51.0
-0.75	95.0
-0.25	139.0
0.25	85.0
0.75	81.0
1.25	47.0
1.75	31.0
2.25	43.0
2.75	13.0
3.25	7.0
3.75	2.0
4.25	1.0
4.75	0.0
5.25	0.0

NEGATIVE VALUES MEAN	=	-0.95
POSITIVE VALUES MEAN	=	1.01
NEGATIVE VARIANCE	=	0.43
POSITIVE VARIANCE	=	0.75
NEGATIVE STANDARD DEVIATION	=	0.66
POSITIVE STANDARD DEVIATION	=	0.87



X-SCALE=5.00E+00 UNITS INCH.

Y-SCALE=2.00E+01 UNITS INCH.

DISTRIBUTION RUN 20 ROLLO6 PITCH00

COURSE 000 E&M DIR. 149 DIST 10.49

VARIATIONS RUN 20 ROLL06 PITCH00
 COURSE 000 E&M DIR. 149 DIST 10.49

VARIATIONS

4.0	-1.0	0.5	-1.0	1.0	-0.5	0.5	-4.5	7.0	-1.0
1.5	-1.0	1.5	-1.0	1.0	-1.0	1.5	-1.5	1.0	-1.0
0.5	-6.0	3.5	-0.5	0.5	-0.5	1.0	-1.0	1.0	-1.0
0.5	-1.0	1.5	-1.0	0.5	-0.5	1.0	-1.5	1.5	-1.0
1.0	-1.5	0.5	-1.0	0.5	-0.5	0.5	-0.5	1.5	-1.0
0.5	-0.5	0.5	-0.5	0.5	-0.5	0.5	-0.5	1.0	-0.5
1.0	-2.0	0.5	-0.5	0.5	-0.5	2.5	-0.5	1.0	-2.0
1.0	-1.0	0.5	-1.5	0.5	-1.0	1.0	-1.0	1.5	-1.0
1.0	-1.0	1.0	-0.5	0.5	-0.5	1.0	-0.5	2.5	-0.5
1.5	-1.0	1.0	-1.0	0.5	-4.0	1.0	-0.5	3.0	-0.5
0.5	-0.5	1.0	-1.0	1.0	-1.0	0.5	-3.5	0.5	-1.0
0.5	-0.5	1.0	-0.5	2.0	-0.5	1.0	-0.5	1.5	-1.0
1.0	-1.5	1.5	-1.5	1.0	-1.0	1.0	-1.5	1.0	-1.0
0.5	-1.0	0.5	-1.0	1.0	-0.5	0.5	-1.0	1.0	-1.0
0.5	-1.0	1.0	-0.5	0.5	-0.5	3.0	-0.5	1.0	-3.0
2.5	-3.0	1.0	-0.5	1.0	-0.5	0.5	-1.0	2.5	-0.5
1.0	-1.5	1.0	-1.5	0.5	-1.0	0.5	-1.0	0.5	-0.5
0.5	-0.5	1.0	-1.0	1.5	-1.5	1.0	-1.0	1.0	-1.0
1.0	-1.0	1.0	-1.0	1.0	-1.0	1.5	-1.5	1.5	-2.0
0.5	-1.5	1.0	-0.5	1.0	-0.5	0.5	-0.5	1.0	-1.0
1.5	-1.0	1.5	-0.5	0.5	-0.5	0.5	-1.5	1.0	-1.5
0.5	-1.0	1.0	-0.5	2.0	-0.5	1.0	-1.5	2.0	-1.0
1.0	-1.0	1.0	-1.0	1.0	-1.5	1.0	-3.5	1.0	-1.0
1.5	-1.0	1.0	-1.0	1.5	-0.5	2.0	-0.5	1.0	-0.5
0.5	-1.5	0.5	-1.0	1.0	-1.5	0.5	-1.5	1.0	-1.0
3.0	-1.0	1.0	-1.0	1.0	-1.0	0.5	-1.0	0.5	-0.5
0.5	-1.0	1.0	-1.0	0.5	-0.5	0.5	-0.5	0.5	-0.5
1.5	-0.5	0.5	-1.5	0.5	-1.0	0.5	-1.0	0.5	-1.0
1.0	-1.0	1.0	-0.5	1.0	-0.5	0.5	-0.5	0.5	-0.5
0.5	-0.5	2.0	-0.5	1.5	-1.0	1.0	-1.5	1.5	-1.5
1.5	-1.5	0.5	-1.5	0.5	-0.5	0.5	-1.0	1.0	-1.5
1.0	-1.0	0.5	-0.5	1.5	-1.0	1.5	-1.0	1.5	-0.5
0.5	-0.5	0.5	-2.0	0.5	-0.5	0.5	-0.5	0.5	-1.0
0.5	-0.5	0.5	-0.5	0.5	-0.5	1.0	-0.5	1.5	-0.5
1.0	-0.5	1.5	-0.5	1.0	-0.5	1.0	-0.5	1.5	-1.0
0.5	-1.5	0.5	-4.5	1.0	-0.5	0.5	-1.5	0.5	-1.0
1.0	-1.0	2.5	-0.5	0.5	-0.5	1.0	-0.5	0.5	-0.5
0.5	-1.5	1.5	-1.0	1.5	-1.5	0.5	-0.5	1.0	-1.5
1.0	-0.5	1.0	-0.5	1.0	-1.0	1.0	-0.5	0.5	-0.5
1.0	-1.5	0.5	-1.5	0.5	-0.5	0.5	-1.0	0.5	-0.0
0.5	-0.5	0.5	-0.5	0.5	-0.5	0.5	-1.0	1.0	-0.5
1.0	-1.5	1.5	-1.0	1.0	-0.5	1.0	-1.5	1.0	-1.5
0.5	-1.0	0.5	-1.0	0.5	-0.5	0.5	-1.5	0.5	-1.5
0.5	-1.0	1.0	-0.5	1.0	-0.5	1.5	-2.5	0.5	-0.0
0.5	-0.5	0.5	-1.5	0.5	-0.5	0.5	-0.5	1.5	-0.5
1.0	-0.5	1.0	-1.0	0.5	-0.0	0.5	-1.0	0.5	-1.0
0.5	-0.5	1.0	-0.5	0.5	-0.5	0.5	-0.5	1.0	-0.5
0.5	-0.5	1.5	-0.5	0.5	-0.5	0.5	-1.0	0.5	-1.0
0.5	-1.5	0.5	-0.5	0.5	-0.5	1.0	-1.0	1.0	-0.5
1.5	-0.5	0.5	-0.5	0.5	-0.5	0.5	-0.5	0.5	-0.5
0.5	-0.5	1.0	-1.0	1.0	-1.0	0.5	-0.5	0.5	-0.5
0.5	-1.0	0.5	-1.0	0.5	-1.5	0.5	-0.5	1.5	-0.5
0.5	-0.5	0.5	-1.0	0.5	-2.0	0.5	-0.5	1.5	-0.5
1.5	-0.5	1.0	-0.5	1.0	-4.0	0.5	-1.0	0.5	-1.0
0.5	-0.5	0.5	-0.5	0.5	0.0	1.0	-0.5	0.5	-0.5
0.5	-0.5	1.0	0.0	-0.5	1.0	-0.5	0.5	-0.5	0.5
-0.5	0.5	-0.5	0.5	-0.5	1.0	-1.0	0.5	-0.5	0.5
-0.5	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.5	-1.0	0.5
-1.0	0.5	-1.0	0.5	-1.0	0.5	-1.0	0.5	-0.5	0.5
-1.5	1.0	-1.0	1.5	-1.0	2.5	-0.5	1.5	-0.5	1.0
-0.5	0.5	-0.5	0.5	-0.5					

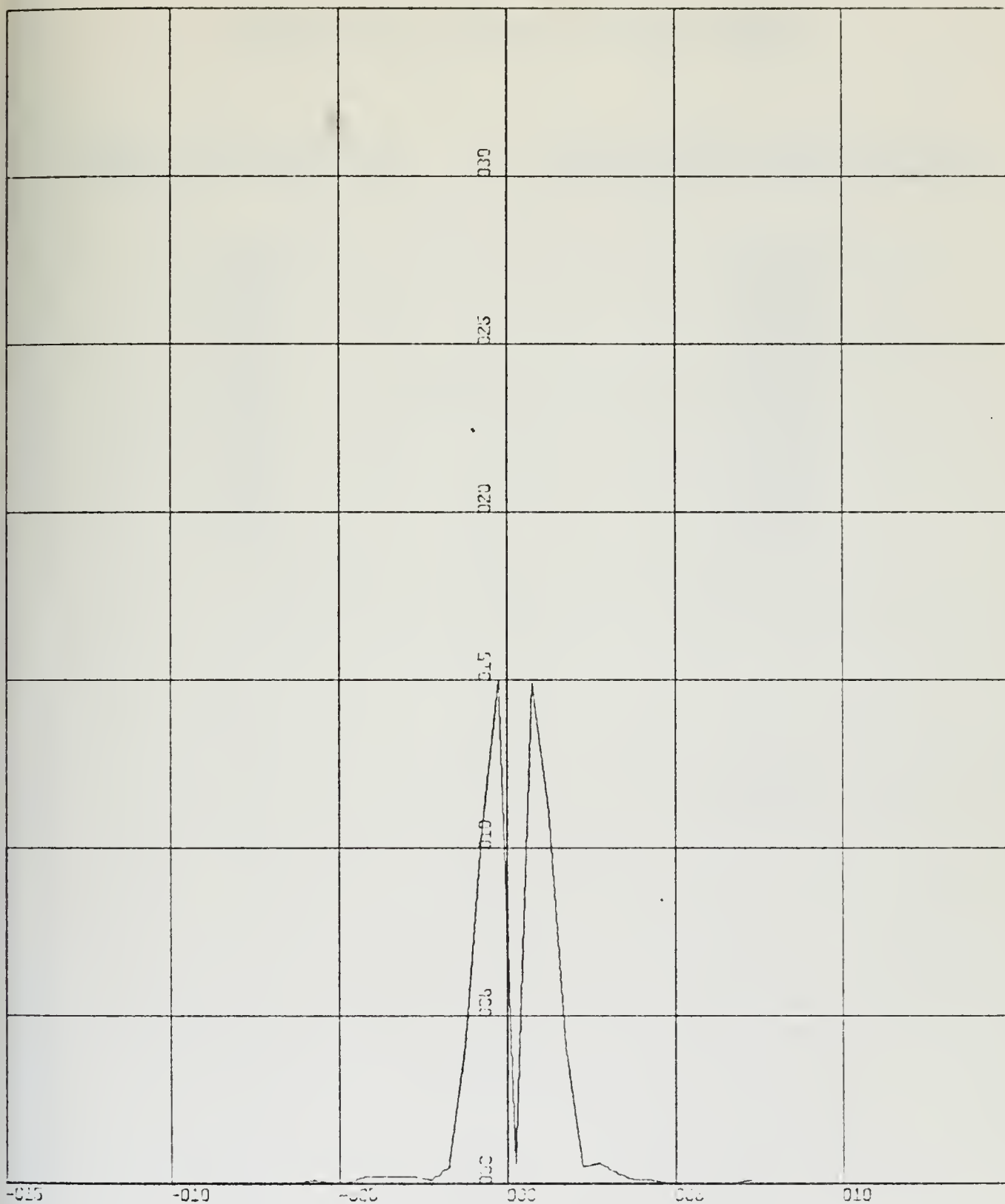
AVE. VARIATION = 0.0DB

STANDARD DEVIATION = 1.3

VARIATIONS RUN 20 ROLL06 PITCH00
 COURSE 000 E&M DIR. 149 DIST 10.49
 GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-7.25	0.0
-6.75	0.0
-6.25	0.0
-5.75	1.0
-5.25	0.0
-4.75	0.0
-4.25	2.0
-3.75	2.0
-3.25	2.0
-2.75	2.0
-2.25	1.0
-1.75	5.0
-1.25	41.0
-0.75	105.0
-0.25	150.0
0.25	6.0
0.75	149.0
1.25	111.0
1.75	41.0
2.25	5.0
2.75	6.0
3.25	3.0
3.75	1.0
4.25	1.0
4.75	0.0
5.25	0.0
5.75	0.0
6.25	0.0
6.75	0.0
7.25	1.0

NEGATIVE VALUES MEAN	=	-0.93
POSITIVE VALUES MEAN	=	0.93
NEGATIVE VARIANCE	=	0.46
POSITIVE VARIANCE	=	0.40
NEGATIVE STANDARD DEVIATION	=	0.68
POSITIVE STANDARD DEVIATION	=	0.63



X-SCALE=5.00E+00 UNITS INCH.

Y-SCALE=5.00E+01 UNITS INCH.

VARIATIONS RUN 20 ROLL06 PITCH00

COURSE 000 E&M DIR. 149 DIST 10.49

VARIATIONS RUN 20 ROLL06 PITCH00
COURSE 000 E&M DIR. 149 DIST 10.49

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

7.00	0.998
6.50	0.998
6.00	0.998
5.50	0.997
5.00	0.997
4.50	0.997
4.00	0.992
3.50	0.987
3.00	0.980
2.50	0.967
2.00	0.957
1.50	0.885
1.00	0.646
0.50	0.246

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLOT	=	031 DEGREES RELATIVE
THETA OF PLOT	=	089 DEGREES RELATIVE
SEA STATE	=	1
DIRECTION OF SEA	=	000 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
-------------------	--------------------	-------------------------

.0	.5	28.868
.0	1.0	28.870
.0	1.5	28.873
.0	1.9	28.877
.0	2.3	28.881
.0	2.6	28.885
.0	2.8	28.889
.0	3.0	28.891
.0	3.0	28.891
.0	3.0	28.891
.0	2.8	28.889
.0	2.6	28.885
.0	2.3	28.881
.0	1.9	28.877
.0	1.5	28.873
.0	1.0	28.870
.0	.5	28.868
.0	-.5	28.868
.0	-1.0	28.870
.0	-1.5	28.873
.0	-1.9	28.877
.0	-2.3	28.881
.0	-2.6	28.885
.0	-2.8	28.889
.0	-3.0	28.891
.0	-3.0	28.891
.0	-3.0	28.891
.0	-2.8	28.889
.0	-2.6	28.885
.0	-2.3	28.881
.0	-1.9	28.877
.0	-1.5	28.873
.0	-1.0	28.870
.0	-.5	28.868

AVERAGE VALUE = -28.88 DB

DISTRIBUTION RUN52 ROLLOO PITCH03
COURSE 180 E&M DIR. 149 DIST 10.94

DATA POINTS

83.5	81.0	85.0	79.5	83.0	80.0	84.5	80.0	85.0
80.5	84.5	81.0	83.5	80.0	84.0	82.0	85.5	79.0
86.0	79.0	83.0	79.5	86.5	81.0	83.0	80.5	82.0
79.0	79.5	79.0	85.0	79.5	84.5	79.5	82.5	79.5
83.5	79.5	82.0	80.0	81.5	80.0	84.0	80.5	83.0
81.5	83.5	81.0	82.0	81.0	82.0	80.5	82.0	81.0
82.5	79.0	84.0	81.0					

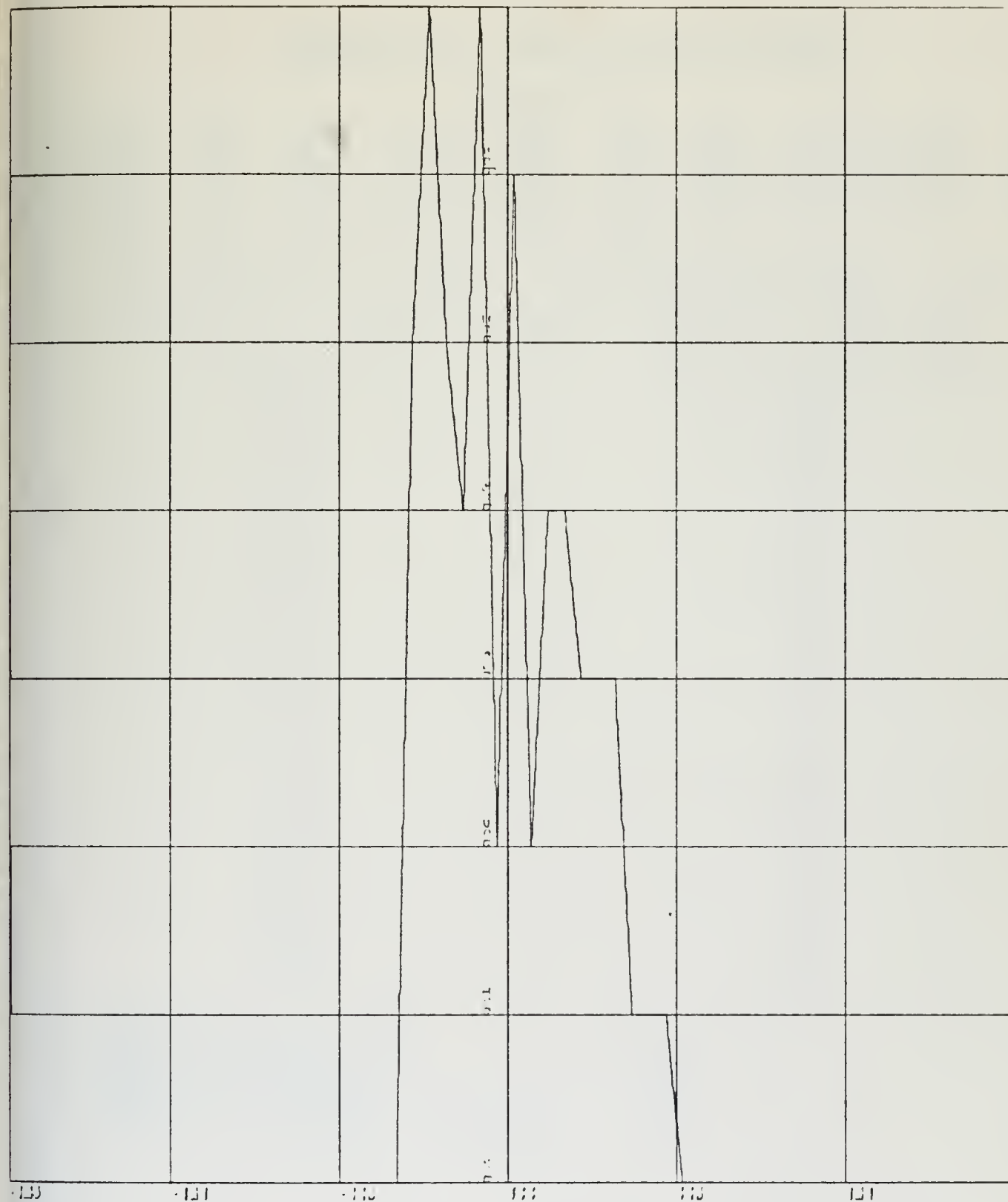
AVERAGE POWER = 81.8DB STANDARD DEVIATION = 4.3

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB POINTS AT THAT POWER

-5.25	0.0
-4.75	0.0
-4.25	0.0
-3.75	0.0
-3.25	0.0
-2.75	5.0
-2.25	7.0
-1.75	5.0
-1.25	4.0
-0.75	7.0
-0.25	2.0
0.25	6.0
0.75	2.0
1.25	4.0
1.75	4.0
2.25	3.0
2.75	3.0
3.25	3.0
3.75	1.0
4.25	1.0
4.75	1.0
5.25	0.0

NEGATIVE VALUES MEAN = -1.69
POSITIVE VALUES MEAN = 1.81
NEGATIVE VARIANCE = 0.65
POSITIVE VARIANCE = 1.70
NEGATIVE STANDARD DEVIATION = 0.81
POSITIVE STANDARD DEVIATION = 1.30



K-SCALE=5.00E+00 UNITS INCH.

K-SCALE=1.00E+00 UNITS INCH.

DISTRIBUTION RUN52 ROLL00 PITCH03

COURSE 100 E&M DIR. 149 DIST 10.94

VARIATIONS RUN52 ROLLOO PITCH03
 COURSE 180 E&M DIR. 149 DIST 10.94

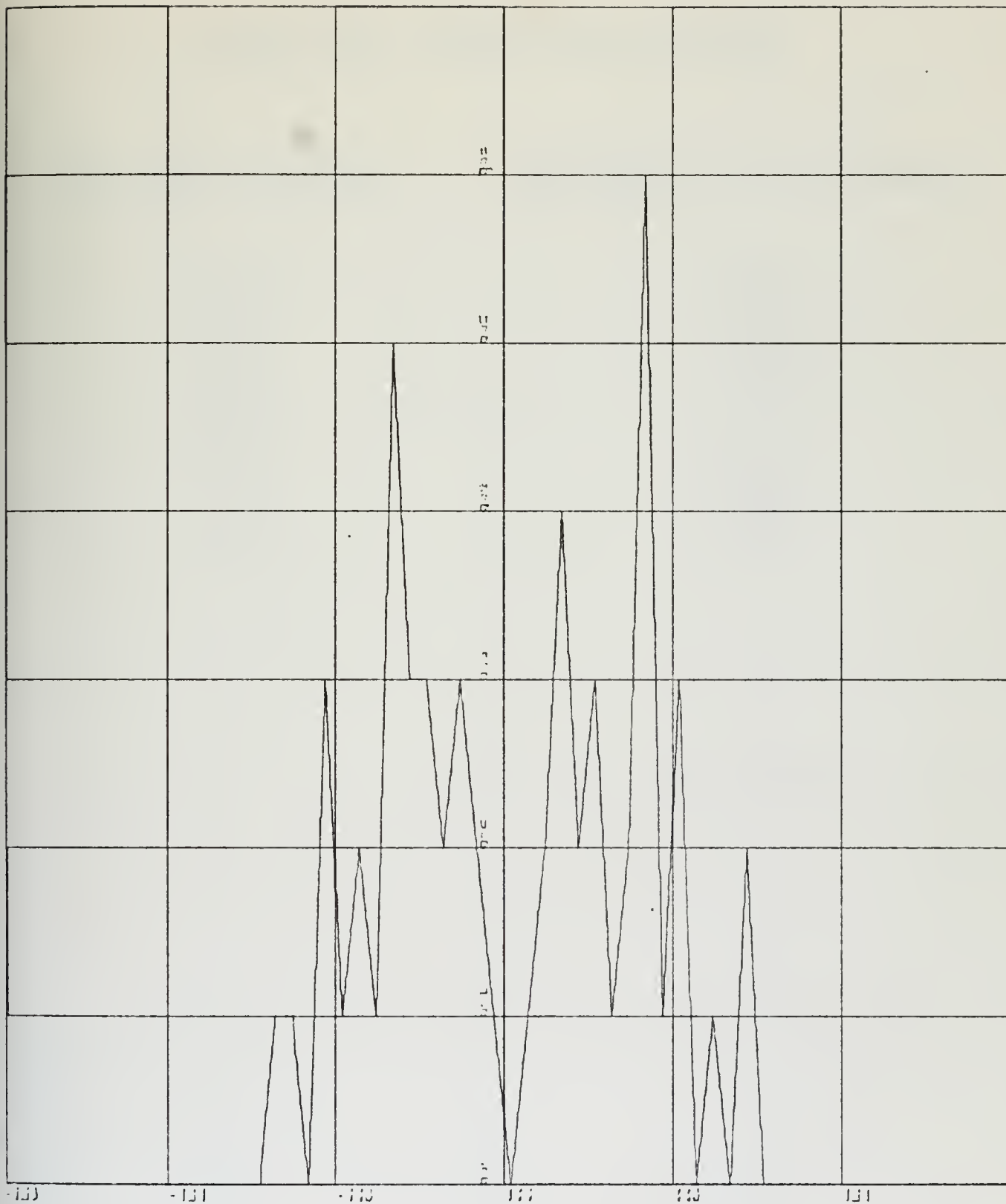
VARIATIONS									
-2.5	4.0	-5.5	3.5	-3.0	4.5	-4.5	5.0	-4.5	4.0
-3.5	2.5	-3.5	4.0	-2.0	3.5	-6.5	7.0	-7.0	4.0
-3.5	7.0	-5.5	2.0	-2.5	1.5	-3.0	0.5	-0.5	6.0
-5.5	5.0	-5.0	3.0	-3.0	4.0	-4.0	2.5	-2.0	1.5
-1.5	4.0	-3.5	2.5	-1.5	2.0	-2.5	1.0	-1.0	1.0
-1.5	1.5	-1.0	1.5	-3.5	5.0				

AVE. VARIATION = 0.0DB STANDARD DEVIATION = 14.3

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-7.25	0.0
-6.75	1.0
-6.25	1.0
-5.75	0.0
-5.25	3.0
-4.75	1.0
-4.25	2.0
-3.75	1.0
-3.25	5.0
-2.75	3.0
-2.25	3.0
-1.75	2.0
-1.25	3.0
-0.75	2.0
-0.25	1.0
0.25	0.0
0.75	1.0
1.25	2.0
1.75	4.0
2.25	2.0
2.75	3.0
3.25	1.0
3.75	2.0
4.25	6.0
4.75	1.0
5.25	3.0
5.75	0.0
6.25	1.0
6.75	0.0
7.25	2.0

NEGATIVE VALUES MEAN	=	-3.32
POSITIVE VALUES MEAN	=	3.34
NEGATIVE VARIANCE	=	2.91
POSITIVE VARIANCE	=	3.13
NEGATIVE STANDARD DEVIATION	=	1.71
POSITIVE STANDARD DEVIATION	=	1.77



K-SCALE=5.00E+00 UNITS INCH.
 Y-SCALE=1.00E+00 UNITS INCH.
 VARIATIONS RUN52 ROLL00 PITCH03
 COURSE 100 E&M DIR. 149 DIST 10.94



VARIATIONS RUN52 ROLLOO PITCH03
COURSE 180 E&M DIR. 149 DIST 10.94

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

7.00	0.964
6.50	0.946
6.00	0.911
5.50	0.911
5.00	0.804
4.50	0.768
4.00	0.625
3.50	0.571
3.00	0.464
2.50	0.357
2.00	0.268
1.50	0.161
1.00	0.071
0.50	0.018

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLOT	=	211 DEGREES RELATIVE
THETA OF PLOT	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	022 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
1.0	.5	3.681
2.0	1.0	1.190
3.0	1.5	2.464
3.9	1.9	3.349
4.6	2.3	2.428
5.2	2.6	1.882
5.6	2.8	1.930
5.9	3.0	2.122
6.0	3.0	2.205
5.9	3.0	2.122
5.6	2.8	1.930
5.2	2.6	1.882
4.6	2.3	2.428
3.9	1.9	3.349
3.0	1.5	2.464
2.0	1.0	1.190
1.0	.5	3.681
-1.0	-.5	3.893
-2.0	-1.0	1.239
-3.0	-1.5	2.255
-3.9	-1.9	3.355
-4.6	-2.3	2.667
-5.2	-2.6	2.006
-5.6	-2.8	1.893
-5.9	-3.0	1.992
-6.0	-3.0	2.049
-5.9	-3.0	1.992
-5.6	-2.8	1.893
-5.2	-2.6	2.006
-4.6	-2.3	2.667
-3.9	-1.9	3.355
-3.0	-1.5	2.255
-2.0	-1.0	1.239
-1.0	-.5	3.893

AVERAGE VALUE = 2.38 DB

DISTRIBUTION RUN54 ROLLO6 PITCH03
COURSE 000 E&M DIR. 149 DIST 10.94

DATA POINTS

86.0	82.0	84.5	83.0	85.0	82.5	84.0	80.5	79.0
84.0	80.5	82.5	80.0	84.5	82.0	84.0	81.0	83.5
81.0	82.0	79.5	82.0	80.5	82.5	80.0	83.5	80.5
81.5	79.5	82.0	81.0	82.0	79.5	82.5	79.0	81.5
80.0	81.5	80.5	83.0	80.0	82.0	81.0	82.0	80.5
81.5	80.0	83.0	80.5	83.0	81.0	85.5	81.0	83.5
80.5	82.0	80.5	81.5	79.5	85.0	80.0	83.5	81.0
82.0	80.5	84.0	78.5	82.0	78.5	84.0	78.0	82.0

AVERAGE POWER = 81.7DB STANDARD DEVIATION = 3.2

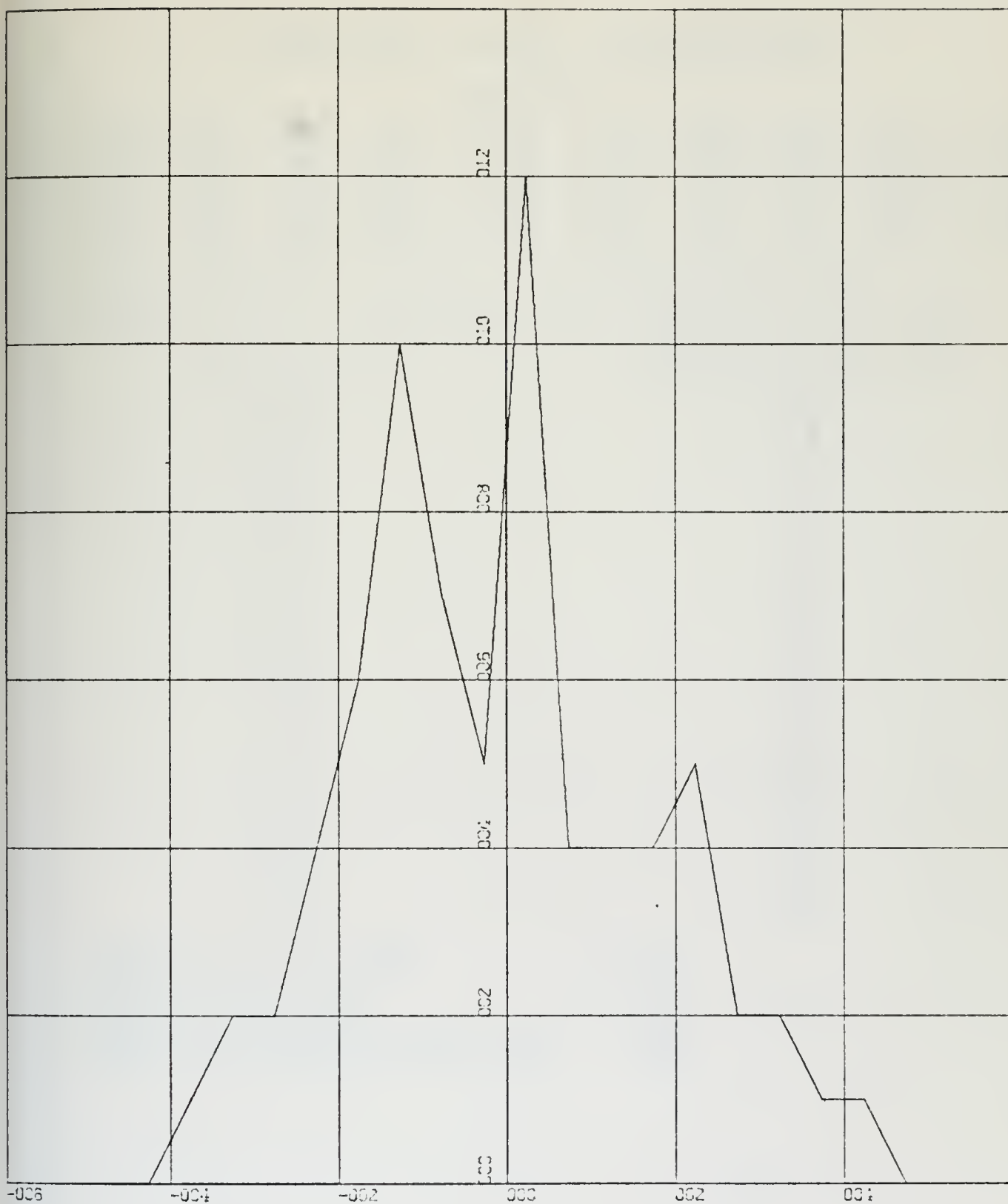
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB POINTS AT THAT POWER

-5.25	0.0
-4.75	0.0
-4.25	0.0
-3.75	1.0
-3.25	2.0
-2.75	2.0
-2.25	4.0
-1.75	6.0
-1.25	10.0
-0.75	7.0
-0.25	5.0
0.25	12.0
0.75	4.0
1.25	4.0
1.75	4.0
2.25	5.0
2.75	2.0
3.25	2.0
3.75	1.0
4.25	1.0
4.75	0.0
5.25	0.0

NEGATIVE VALUES MEAN	=	-1.40
POSITIVE VALUES MEAN	=	1.48
NEGATIVE VARIANCE	=	0.81
POSITIVE VARIANCE	=	1.35
NEGATIVE STANDARD DEVIATION	=	0.90
POSITIVE STANDARD DEVIATION	=	1.16





X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=2.00E+00 UNITS INCH.

DISTRIBUTION RUN54 ROLL06 PITCH03

COURSE 000 E&M DIR. 149 DIST 10.94

VARIATIONS RUN54 ROLL06 PITCH03
COURSE 000 E&M DIR. 149 DIST 10.94

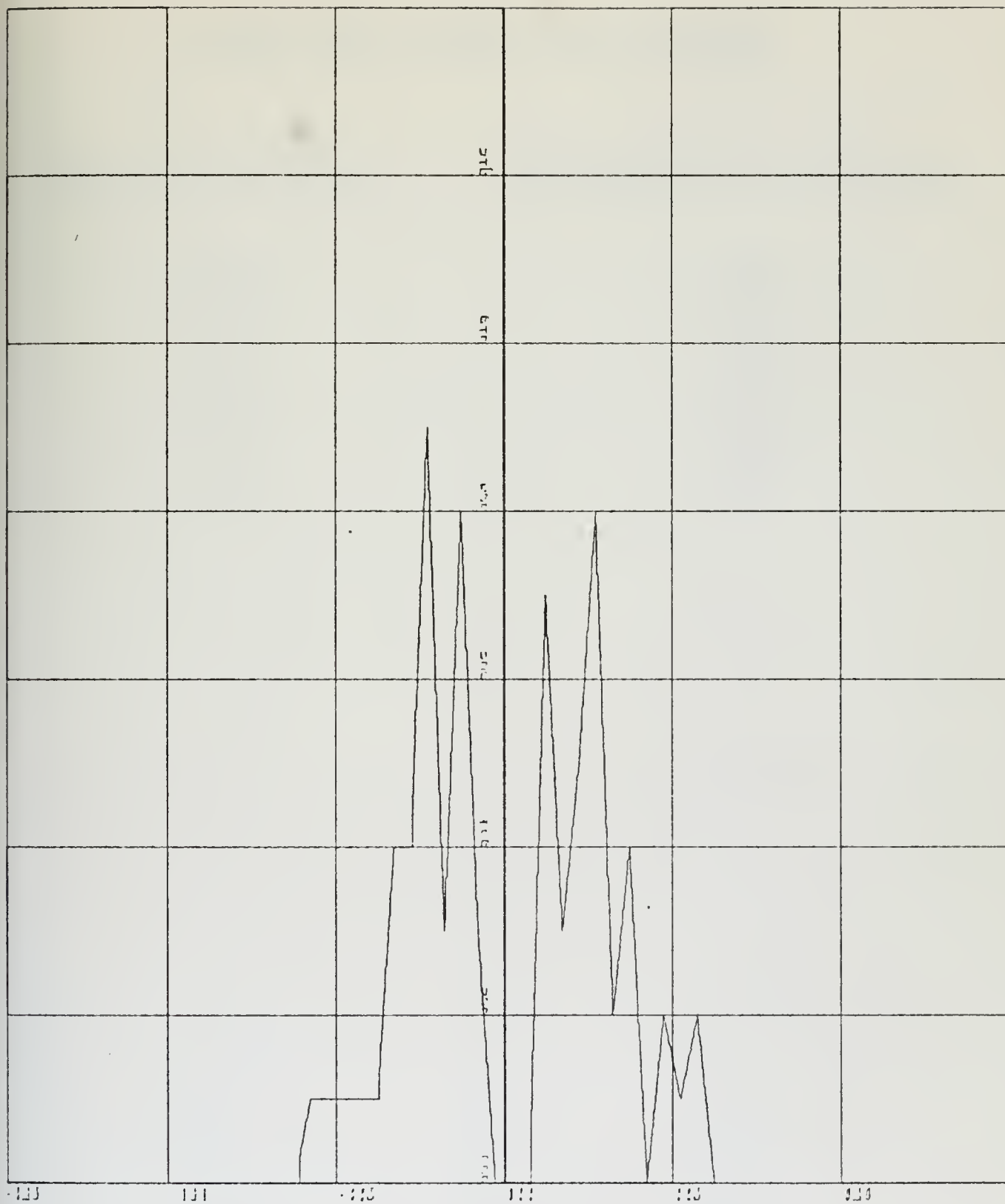
VARIATIONS									
-4.0	2.5	-1.5	2.0	-2.5	1.5	-3.5	-1.5	5.0	-3.5
2.0	-2.5	4.5	-2.5	2.0	-3.0	2.5	-2.5	1.0	-2.5
2.5	-1.5	2.0	-2.5	3.5	-3.0	1.0	-2.0	2.5	-1.0
1.0	-2.5	3.0	-3.5	2.5	-1.5	1.5	-1.0	2.5	-3.0
2.0	-1.0	1.0	-1.5	1.0	-1.5	3.0	-2.5	2.5	-2.0
4.5	-4.5	2.5	-3.0	1.5	-1.5	1.0	-2.0	5.5	-5.0
3.5	-2.5	1.0	-1.5	3.5	-5.5	3.5	-3.5	5.5	-6.0

AVE. VARIATION = -0.1DB STANDARD DEVIATION = 8.4

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-6.25	0.0
-5.75	1.0
-5.25	1.0
-4.75	1.0
-4.25	1.0
-3.75	1.0
-3.25	4.0
-2.75	4.0
-2.25	9.0
-1.75	3.0
-1.25	8.0
-0.75	3.0
-0.25	0.0
0.25	0.0
0.75	0.0
1.25	7.0
1.75	3.0
2.25	5.0
2.75	8.0
3.25	2.0
3.75	4.0
4.25	0.0
4.75	2.0
5.25	1.0
5.75	2.0
6.25	0.0

NEGATIVE VALUES MEAN	=	-2.62
POSITIVE VALUES MEAN	=	2.54
NEGATIVE VARIANCE	=	1.53
POSITIVE VARIANCE	=	1.72
NEGATIVE STANDARD DEVIATION	=	1.24
POSITIVE STANDARD DEVIATION	=	1.31



K-SCALE: 5.00E+00 UNITS INCH.

V-SCALE: 2.00E+00 UNITS INCH.

VARIATIONS RUN54 ROLL06 PITCH03

COURSE 000 E&M DIR. 149 DIST 10.94

VARIATIONS RUN54 ROLL06 PITCH03
COURSE 000 E&M DIR. 149 DIST 10.94

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

6.00	1.000
5.50	0.957
5.00	0.929
4.50	0.886
4.00	0.871
3.50	0.800
3.00	0.714
2.50	0.543
2.00	0.343
1.50	0.257
1.00	0.043
0.50	0.0

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLBT	=	301 DEGREES RELATIVE
THETA OF PLBT	=	089 DEGREES RELATIVE
SEA STATE	=	1
DIRECTION OF SEA	=	049 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
1.0	.0	3.635
2.1	.0	1.182
3.0	.0	2.494
3.9	.0	3.305
4.6	.0	2.340
5.2	.0	1.823
5.7	.0	1.903
5.9	.0	2.109
6.0	.0	2.194
5.9	.0	2.109
5.7	.0	1.903
5.2	.0	1.823
4.6	.0	2.340
3.9	.0	3.305
3.0	.0	2.494
2.1	.0	1.182
1.0	.0	3.635
-1.0	.0	3.849
-2.1	.0	1.231
-3.0	.0	2.288
-3.9	.0	3.335
-4.6	.0	2.586
-5.2	.0	1.941
-5.7	.0	1.857
-5.9	.0	1.974
-6.0	.0	2.036
-5.9	.0	1.974
-5.7	.0	1.857
-5.2	.0	1.941
-4.6	.0	2.586
-3.9	.0	3.335
-3.0	.0	2.288
-2.1	.0	1.231
-1.0	.0	3.849

AVERAGE VALUE = 2.35 DB

DISTRIBUTION RUN55 ROLL06 PITCH00
COURSE 090 E&M DIR. 149 DIST 10.94

DATA POINTS

79.0	82.0	80.0	81.5	79.0	82.0	81.0	84.5	78.0
82.5	77.5	84.0	78.5	84.0	78.0	81.5	78.0	81.0
77.5	80.5	79.5	80.5	78.0	80.5	79.0	80.0	77.5
81.0	78.0	80.5	78.5	84.0	79.5	83.0	77.5	82.0
77.5	81.0	77.0	80.5	78.5	81.0	77.0	81.0	78.5
79.5	78.5	80.0	78.5	80.0	79.0	80.0	77.0	83.0
78.0	81.0	77.0	85.0	78.0	79.0	78.0	82.5	77.5
86.0	78.5	80.0	78.0	81.0	77.5	81.5	78.0	81.0
78.0	80.0	78.0	87.0	78.0	80.0	77.5	85.0	78.5
81.0	78.0	82.0	78.5	80.0	77.0	80.0	78.5	80.5
77.0	79.5	78.0	81.5	78.0	80.0	78.0	80.5	78.0
82.0	78.5	81.0	77.5	81.0				

AVERAGE POWER = 79.8DB STANDARD DEVIATION = 4.7

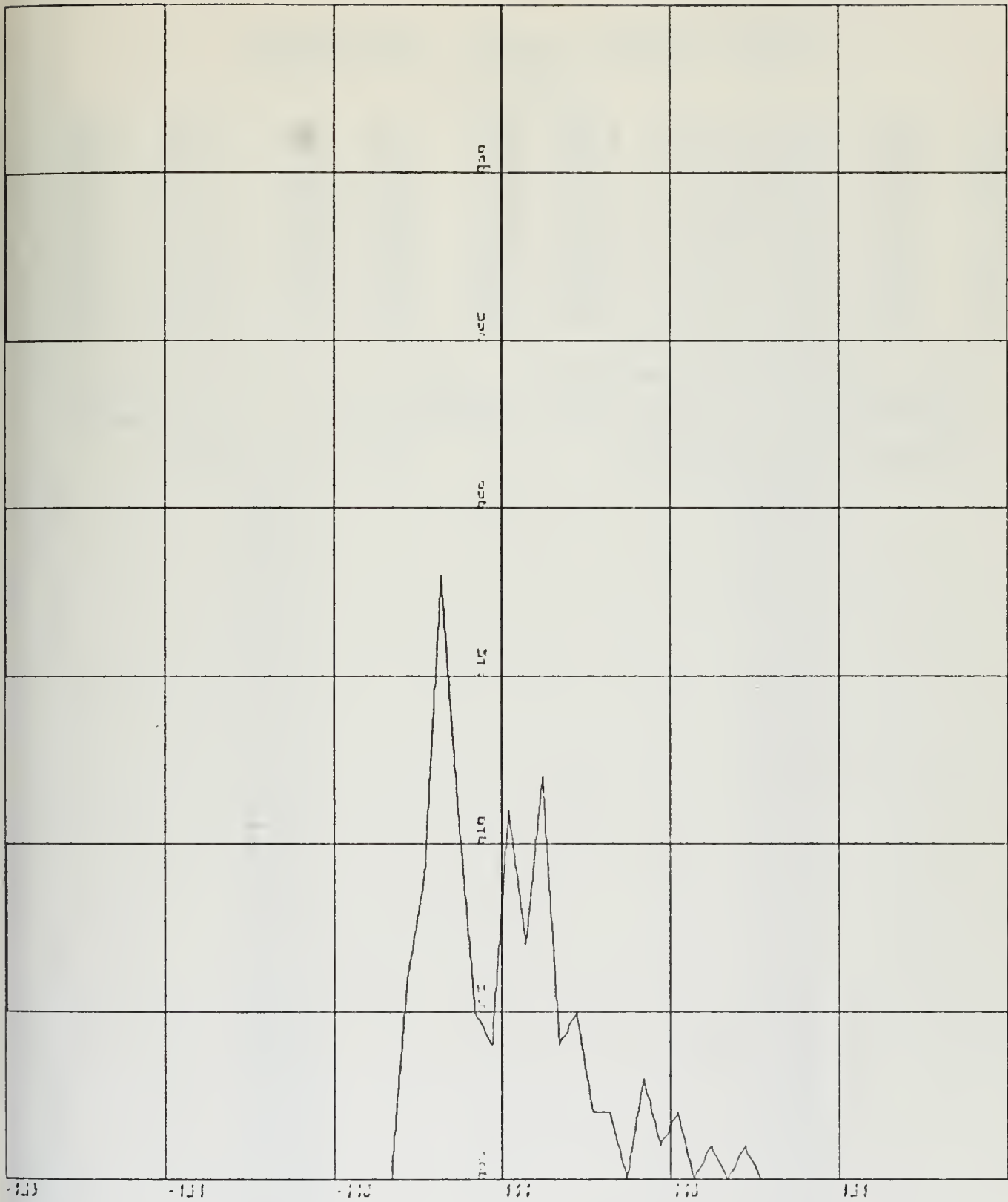
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-8.25	0.0
-7.75	0.0
-7.25	0.0
-6.75	0.0
-6.25	0.0
-5.75	0.0
-5.25	0.0
-4.75	0.0
-4.25	0.0
-3.75	0.0
-3.25	0.0
-2.75	6.0
-2.25	9.0
-1.75	18.0
-1.25	11.0
-0.75	5.0
-0.25	4.0
0.25	11.0
0.75	7.0
1.25	12.0
1.75	4.0
2.25	5.0
2.75	2.0
3.25	2.0
3.75	0.0
4.25	3.0
4.75	1.0
5.25	2.0
5.75	0.0
6.25	1.0
6.75	0.0
7.25	1.0
7.75	0.0
8.25	0.0

NEGATIVE VALUES MEAN	=	-1.71
POSITIVE VALUES MEAN	=	1.78
NEGATIVE VARIANCE	=	0.47
POSITIVE VARIANCE	=	2.89
NEGATIVE STANDARD DEVIATION	=	0.68
POSITIVE STANDARD DEVIATION	=	1.70



K-SCALE=5.00E+00 UNITS INCH.
 K-SCALE=5.00E+00 UNITS INCH.
 DISTRIBUTION RUN55 ROLLO6 PITCH00
 COURSE 090 E&M DIR. 149 DIST 10.94

VARIATIONS RUN55 ROLL06 PITCH00
COURSE 090 E&M DIR. 149 DIST 10.94

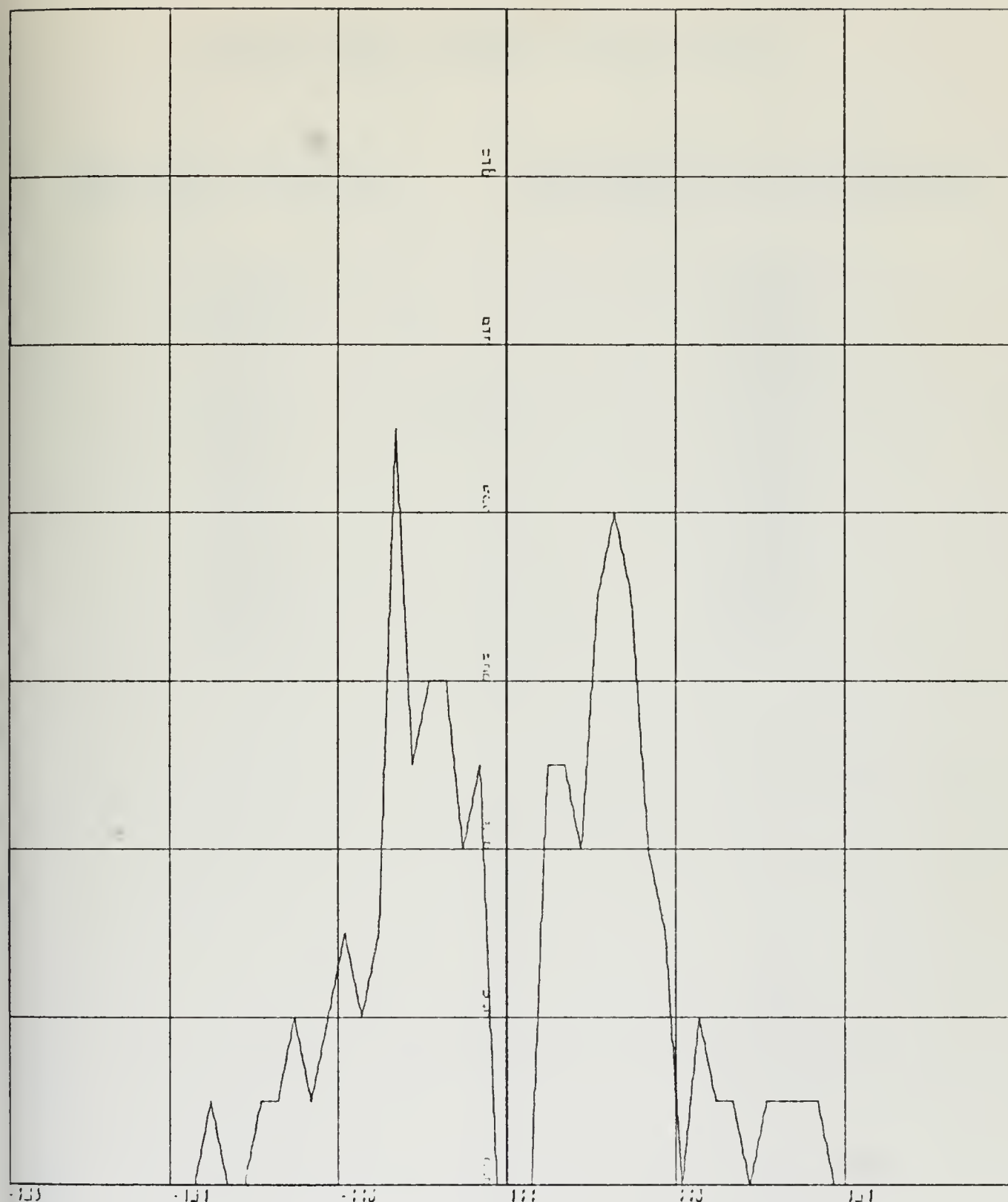
VARIATIONS			
3.0	-2.0	1.5	-2.5
6.5	-5.5	5.5	-6.0
1.0	-2.5	2.5	-1.5
5.5	-4.5	3.5	-5.5
2.5	-4.0	4.0	-2.5
1.0	-3.0	6.0	-5.0
4.5	-5.0	8.5	-7.5
3.0	-3.0	2.0	-2.0
2.5	-3.0	4.0	-3.5
2.5	-1.5	3.5	-3.5
2.5	-3.5		

AVE. VARIATION = -0.0DB STANDARD DEVIATION = 15.2

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-9.25	0.0
-8.75	1.0
-8.25	0.0
-7.75	0.0
-7.25	1.0
-6.75	1.0
-6.25	2.0
-5.75	1.0
-5.25	2.0
-4.75	3.0
-4.25	2.0
-3.75	3.0
-3.25	9.0
-2.75	5.0
-2.25	6.0
-1.75	6.0
-1.25	4.0
-0.75	5.0
-0.25	0.0
0.25	0.0
0.75	0.0
1.25	5.0
1.75	5.0
2.25	4.0
2.75	7.0
3.25	8.0
3.75	7.0
4.25	4.0
4.75	3.0
5.25	0.0
5.75	2.0
6.25	1.0
6.75	1.0
7.25	0.0
7.75	1.0
8.25	1.0
8.75	1.0
9.25	1.0

NEGATIVE VALUES MEAN	=	-3.41
POSITIVE VALUES MEAN	=	3.38
NEGATIVE VARIANCE	=	3.36
POSITIVE VARIANCE	=	3.75
NEGATIVE STANDARD DEVIATION	=	1.83
POSITIVE STANDARD DEVIATION	=	1.94



K-SCALE=5.00E+00 UNITS INCH.

Y-SCALE=2.00E+00 UNITS INCH.

VARIATIONS RUN55 ROLL06 PITCH00

COURSE 090 E&M DIR. 149 DIST 10.94

VARIATIONS RUN55 ROLL06 PITCH00
COURSE 090 E&M DIR. 149 DIST 10.94

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

9.00	0.990
8.50	0.971
8.00	0.961
7.50	0.951
7.00	0.941
6.50	0.922
6.00	0.892
5.50	0.863
5.00	0.843
4.50	0.784
4.00	0.725
3.50	0.627
3.00	0.461
2.50	0.343
2.00	0.245
1.50	0.137
1.00	0.049
0.50	0.0

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLOT	=	010 DEGREES RELATIVE
THETA OF PLOT	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	061 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
2.4	.0	1.455
4.8	.0	2.214
7.0	.0	2.963
9.0	.0	2.240
10.7	.0	2.720
12.1	.0	2.306
13.1	.0	2.683
13.8	.0	2.780
14.0	.0	2.751
13.8	.0	2.780
13.1	.0	2.683
12.1	.0	2.306
10.7	.0	2.720
9.0	.0	2.240
7.0	.0	2.963
4.8	.0	2.214
2.4	.0	1.455
-2.4	.0	1.383
-4.8	.0	2.422
-7.0	.0	2.896
-9.0	.0	2.155
-10.7	.0	2.810
-12.1	.0	2.323
-13.1	.0	2.472
-13.8	.0	2.704
-14.0	.0	2.750
-13.8	.0	2.704
-13.1	.0	2.472
-12.1	.0	2.323
-10.7	.0	2.810
-9.0	.0	2.155
-7.0	.0	2.896
-4.8	.0	2.422
-2.4	.0	1.383

AVERAGE VALUE = 2.43 DB

DISTRIBUTION RUN56 ROLL14 PITCH00
COURSE 160 E&M DIR. 150 DIST 9.21 .

DATA POINTS

78.5	80.0	79.0	79.5	78.5	81.0	77.0	78.5	77.5
79.0	77.0	82.0	79.0	83.0	80.5	78.0	81.0	77.5
82.5	79.0	79.5	78.5	81.0	79.0	81.0	80.0	80.5
80.0	80.5	79.5	82.0	79.5	80.5	79.5	80.0	79.5
82.0	79.0	82.0	79.0	83.5	81.5	82.5	78.0	83.0
80.0	81.0	80.5	81.5	80.5	82.0	79.0	82.5	79.0
81.5	78.5	82.5	79.0	84.0	78.0	83.0	79.5	82.0
79.0	85.5	81.0	82.0	80.0	81.5	79.0	84.0	79.0
84.0	80.5	82.5	79.5	84.5	80.0	83.5	78.5	83.0
79.0	83.0	80.0	87.0	79.0	83.5	81.0	82.0	79.0
83.5	79.5	82.0	81.5	82.5	80.0	84.0	80.5	84.5
82.5	83.5	81.0	83.0	79.5	83.5	79.0	84.0	78.5
84.0	79.5	80.0	79.0	82.0	81.5	82.0	80.0	78.5
85.0	79.0	83.0	81.5	82.0	78.0	85.5	80.0	81.0
79.0	85.5	77.5	81.0	80.5	83.0	78.5	82.5	80.0
83.5	80.5	81.5	80.0	81.0	80.0	80.5	79.5	81.5
78.5	84.0	77.5	82.5	79.0	83.0	79.5	80.5	78.5
80.5	82.5	78.0	82.0	78.0	80.5	76.0	81.0	76.5
78.0	80.0	76.5	79.5					

AVERAGE POWER = 80.7DB STANDARD DEVIATION = 4.3

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

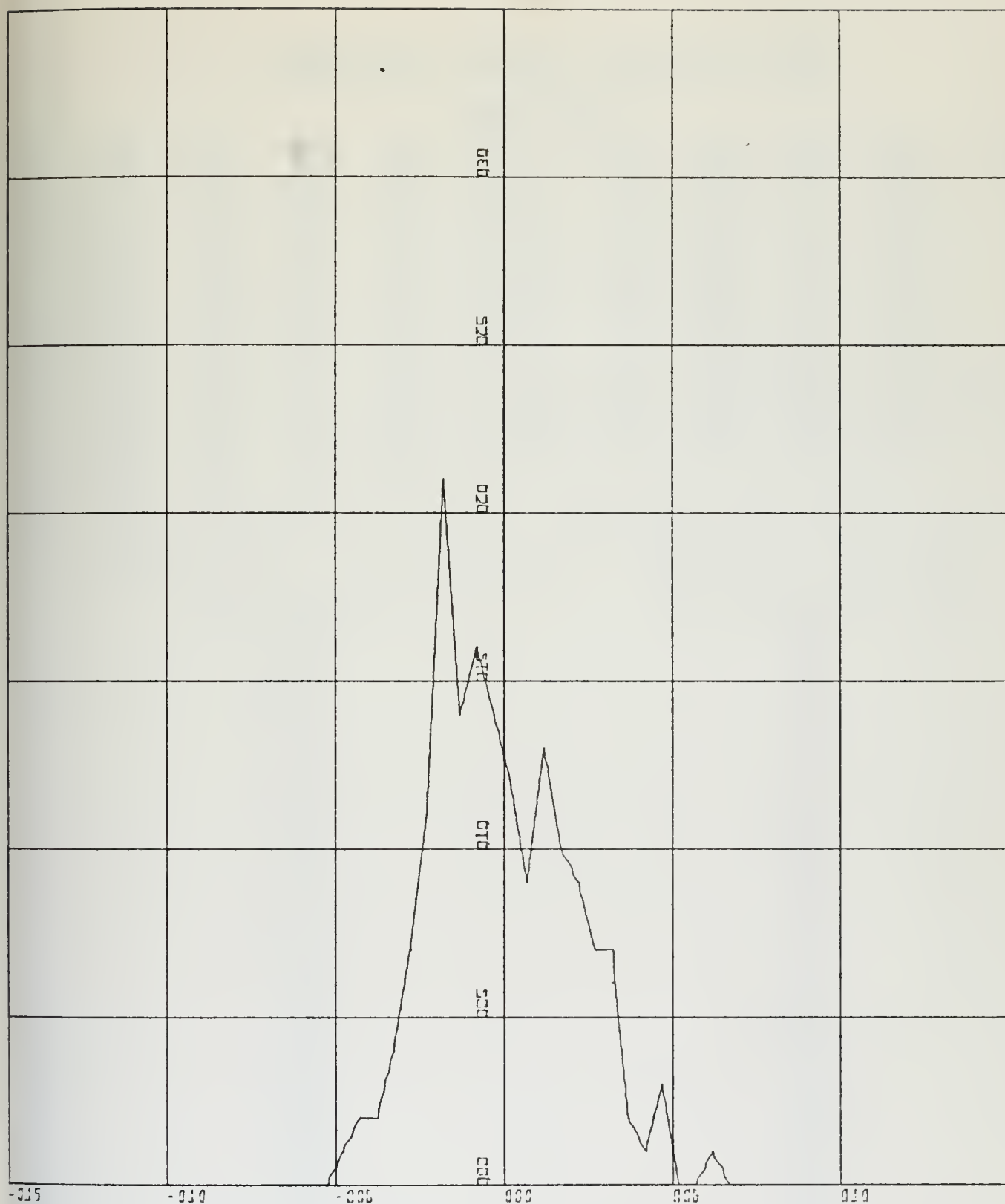
NORMALIZED POWER, DB

POINTS AT THAT POWER

-7.25	0.0
-6.75	0.0
-6.25	0.0
-5.75	0.0
-5.25	0.0
-4.75	1.0
-4.25	2.0
-3.75	2.0
-3.25	4.0
-2.75	7.0
-2.25	11.0
-1.75	21.0
-1.25	14.0
-0.75	16.0
-0.25	14.0
0.25	12.0
0.75	9.0
1.25	13.0
1.75	10.0
2.25	9.0
2.75	7.0
3.25	7.0
3.75	2.0
4.25	1.0
4.75	3.0
5.25	0.0
5.75	0.0
6.25	1.0
6.75	0.0
7.25	0.0

NEGATIVE VALUES MEAN	=	-1.55
POSITIVE VALUES MEAN	=	1.92
NEGATIVE VARIANCE	=	1.07
POSITIVE VARIANCE	=	1.71
NEGATIVE STANDARD DEVIATION	=	1.03
POSITIVE STANDARD DEVIATION	=	1.31





X-SCALE:-5.00E+00 UNITS INCH.

Y-SCALE:-5.00E+00 UNITS INCH.

DISTRIBUTION RUN56 ROLL14 PITCH00

COURSE 160 E&M DIR. 150 DIST 9.21

VARIATIONS RUN56 ROLL14 PITCH00
 COURSE 160 E&M DIR. 150 DIST 9.21

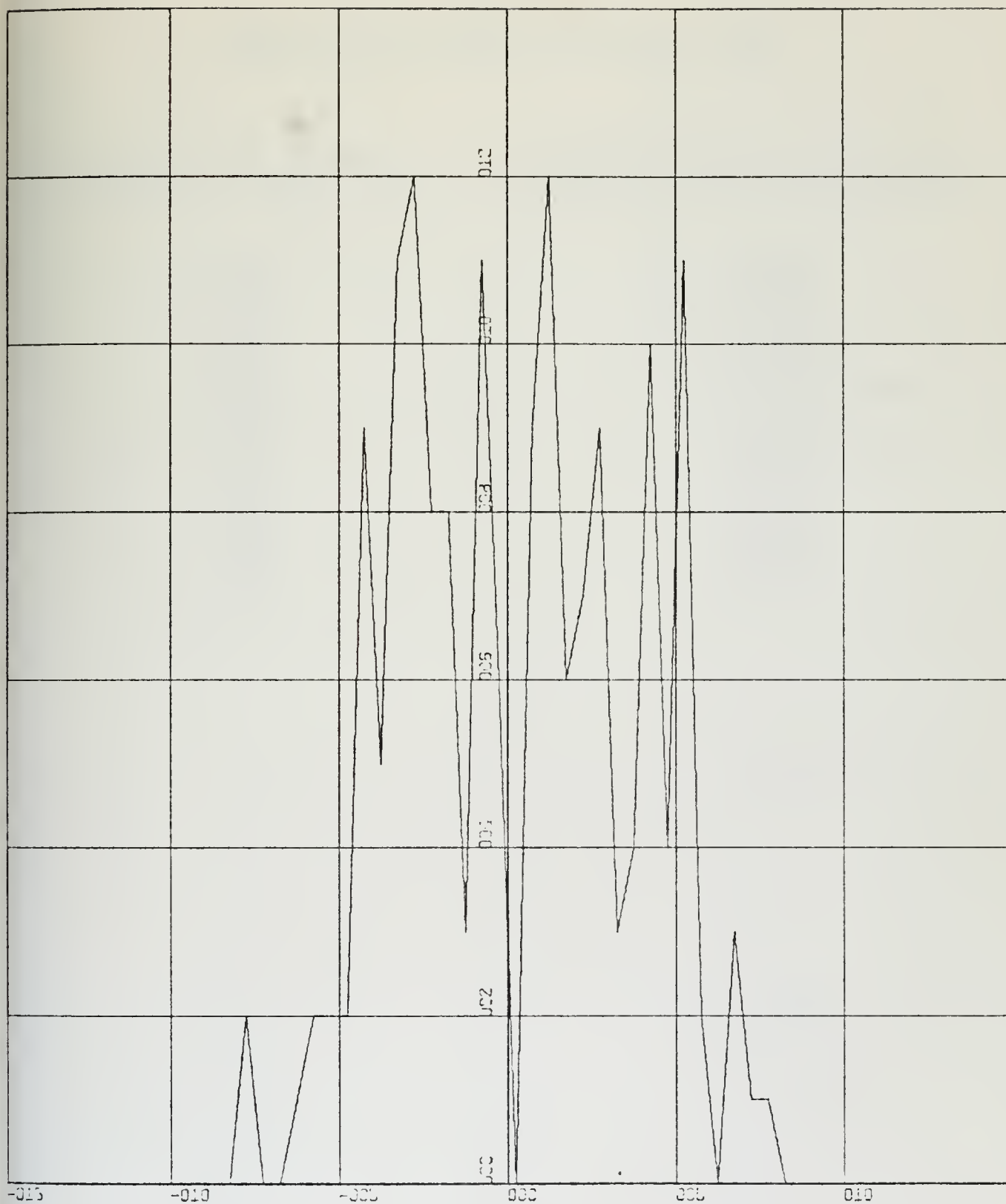
VARIATIONS									
1.5	-1.0	0.5	-1.0	2.5	-4.0	1.5	-1.0	1.5	-2.0
5.0	-3.0	4.0	-2.5	-2.5	3.0	-3.5	5.0	-3.5	0.5
-1.0	2.5	-2.0	2.0	-1.0	0.5	-0.5	0.5	-1.0	2.5
-2.5	1.0	-1.0	0.5	-0.5	2.5	-3.0	3.0	-3.0	4.5
-2.0	1.0	-4.5	5.0	-3.0	1.0	-0.5	1.0	-1.0	1.5
-3.0	3.5	-3.5	2.5	-3.0	4.0	-3.5	5.0	-6.0	5.0
-3.5	2.5	-3.0	6.5	-4.5	1.0	-2.0	1.5	-2.5	5.0
-5.0	5.0	-3.5	2.0	-3.0	5.0	-4.5	3.5	-5.0	4.5
-4.0	4.0	-3.0	7.0	-8.0	4.5	-2.5	1.0	-3.0	4.5
-4.0	2.5	-0.5	1.0	-2.5	4.0	-3.5	4.0	-2.0	1.0
-2.5	2.0	-3.5	4.0	-4.5	5.0	-5.5	5.5	-4.5	0.5
-1.0	3.0	-0.5	0.5	-2.0	-1.5	6.5	-6.0	4.0	-1.5
0.5	-4.0	7.5	-5.5	1.0	-2.0	6.5	-8.0	3.5	-0.5
2.5	-4.5	4.0	-2.5	3.5	-3.0	1.0	-1.5	1.0	-1.0
0.5	-1.0	2.0	-3.0	5.5	-6.5	5.0	-3.5	4.0	-3.5
1.0	-2.0	2.0	-2.0	-4.5	4.0	-4.0	2.5	-4.5	5.0
-4.5	1.5	2.0	-3.5						

AVE. VARIATION = -0.0DB STANDARD DEVIATION = 12.0

GRAPHED DATA IS; VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-8.25	0.0
-7.75	2.0
-7.25	0.0
-6.75	0.0
-6.25	1.0
-5.75	2.0
-5.25	2.0
-4.75	2.0
-4.25	9.0
-3.75	5.0
-3.25	11.0
-2.75	12.0
-2.25	8.0
-1.75	8.0
-1.25	3.0
-0.75	11.0
-0.25	6.0
0.25	0.0
0.75	9.0
1.25	12.0
1.75	6.0
2.25	7.0
2.75	9.0
3.25	3.0
3.75	4.0
4.25	10.0
4.75	4.0
5.25	11.0
5.75	2.0
6.25	0.0
6.75	3.0
7.25	1.0
7.75	1.0
8.25	0.0

NEGATIVE VALUES MEAN = -2.99
 POSITIVE VALUES MEAN = 2.96
 NEGATIVE VARIANCE = 2.80
 POSITIVE VARIANCE = 3.41
 NEGATIVE STANDARD DEVIATION = 1.67
 POSITIVE STANDARD DEVIATION = 1.85



X-SCALE:-5.00E+00 UNITS INCH.

Y-SCALE:-2.00E+00 UNITS INCH.

VARIATIONS RUN56 ROLL14 PITCH00

COURSE 160 E&M DIR. 150 DIST 9.21

VARIATIONS RUN56 ROLL14 PITCH00
COURSE 160 E&M DIR. 150 DIST 9.21

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

8.00	1.000
7.50	0.982
7.00	0.976
6.50	0.957
6.00	0.951
5.50	0.927
5.00	0.848
4.50	0.811
4.00	0.695
3.50	0.640
3.00	0.555
2.50	0.427
2.00	0.335
1.50	0.250
1.00	0.159
0.50	0.037

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLOT	=	298 DEGREES RELATIVE
THETA OF PLOT	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	018 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
.9	.0	4.874
1.7	.0	1.450
2.5	.0	1.487
3.2	.0	2.803
3.8	.0	3.345
4.3	.0	2.842
4.6	.0	2.307
4.9	.0	2.045
4.9	.0	1.976
4.9	.0	2.045
4.6	.0	2.307
4.3	.0	2.842
3.8	.0	3.345
3.2	.0	2.803
2.5	.0	1.487
1.7	.0	1.450
.9	.0	4.874
-.9	.0	5.079
-1.7	.0	1.590
-2.5	.0	1.414
-3.2	.0	2.589
-3.8	.0	3.325
-4.3	.0	3.046
-4.6	.0	2.554
-4.9	.0	2.264
-4.9	.0	2.179
-4.9	.0	2.264
-4.6	.0	2.554
-4.3	.0	3.046
-3.8	.0	3.325
-3.2	.0	2.589
-2.5	.0	1.414
-1.7	.0	1.590
-.9	.0	5.079

AVERAGE VALUE = 2.65 DB

DISTRIBUTION RUN57 ROLL05 PITCH00
COURSE 090 E&M DIR. 152 DIST 7.48

DATA POINTS

78.0	78.0	78.5	76.5	78.5	76.5	77.5	76.5	78.0
77.0	76.0	78.0	76.5	78.0	76.0	78.0	76.0	79.0
75.5	79.5	76.0	79.5	76.0	79.0	76.5	77.5	76.5
78.0	76.0	77.0	76.5	79.0	76.0	77.5	76.0	77.0
76.0	79.0	76.0	81.5	76.0	81.0	76.0	77.0	75.5
78.5	76.5	78.0	76.0	78.0	76.0	76.0	77.0	76.0
77.0	75.0	77.5	75.0	78.0	76.0	76.5	76.0	77.5
75.5	77.5	75.5	77.0	76.0	77.0	75.5	77.0	75.0
77.0	75.0	76.0	75.0	76.5	75.0	75.5	75.0	76.5
75.0	77.5	76.0	75.0	76.5	75.0	77.0	75.0	77.0

AVERAGE POWER = 76.8DB STANDARD DEVIATION = 1.8

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-5.25	0.0
-4.75	0.0
-4.25	0.0
-3.75	0.0
-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	11.0
-1.25	6.0
-0.75	21.0
-0.25	12.0
0.25	12.0
0.75	7.0
1.25	10.0
1.75	3.0
2.25	4.0
2.75	2.0
3.25	0.0
3.75	0.0
4.25	1.0
4.75	1.0
5.25	0.0

NEGATIVE VALUES MEAN	=	-0.95
POSITIVE VALUES MEAN	=	1.19
NEGATIVE VARIANCE	=	0.29
POSITIVE VARIANCE	=	1.13
NEGATIVE STANDARD DEVIATION	=	0.54
POSITIVE STANDARD DEVIATION	=	1.07



K-SCALE-5.00E+00 UNITS INCH.

V-SCALE-5.00E+00 UNITS INCH.

DISTRIBUTION RUNS7 ROLL05 PITCH00

COURSE 090 E&M DIR. 152 DIST 7.40

VARIATIONS RUN57 ROLL05 PITCH00
 COURSE 090 E&M DIR. 152 DIST 7.48

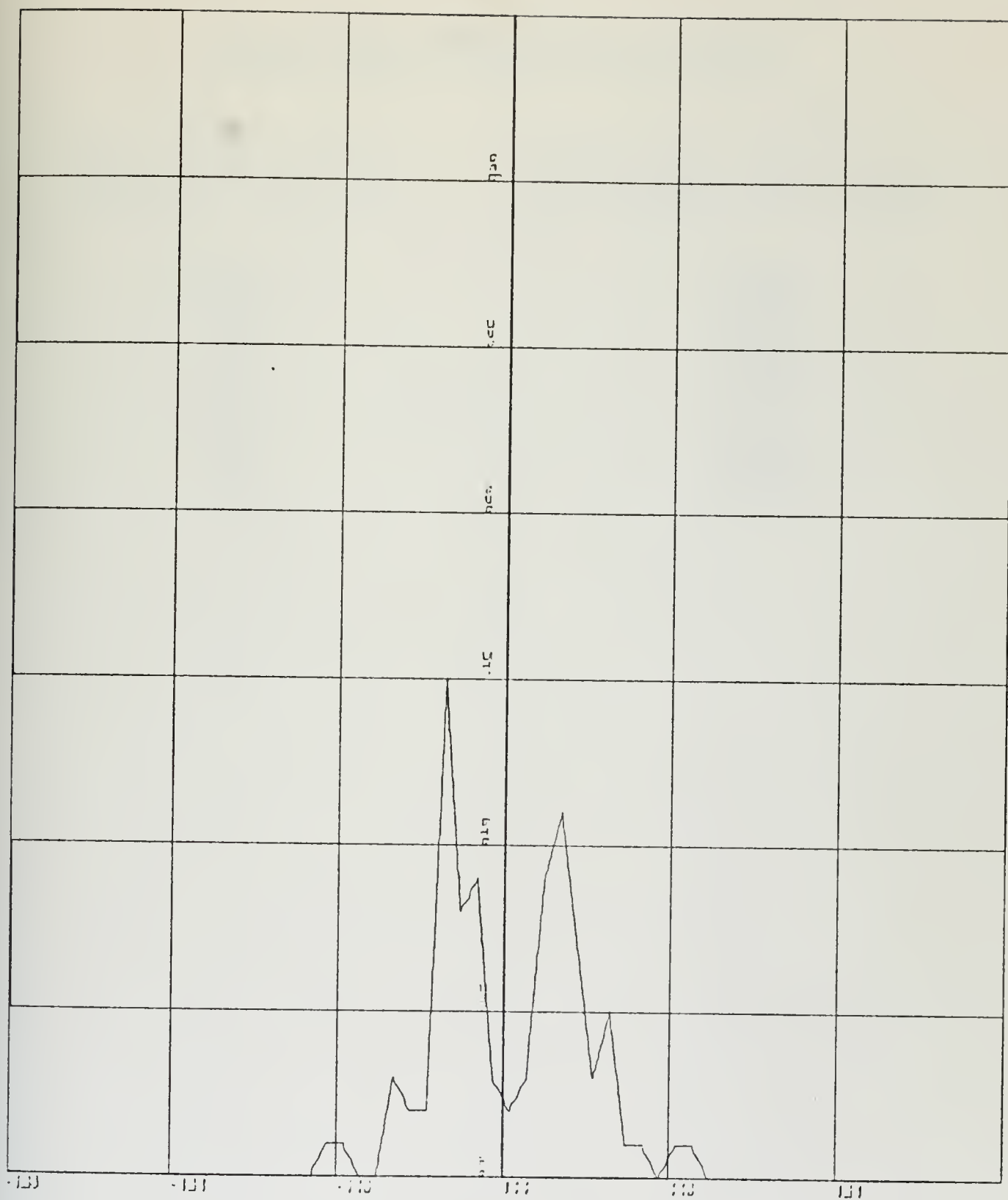
VARIATIONS									
0.0	0.5	-2.0	2.0	-2.0	1.0	-1.0	1.5	-1.0	-1.0
2.0	-1.5	1.5	-2.0	2.0	-2.0	3.0	-3.5	4.0	-3.5
3.5	-3.5	3.0	-2.5	1.0	-1.0	1.5	-2.0	1.0	-0.5
2.5	-3.0	1.5	-1.5	1.0	-1.0	3.0	-3.0	5.5	-5.5
5.0	-5.0	1.0	-1.5	3.0	-2.0	1.5	-2.0	2.0	-2.0
0.0	1.0	-1.0	1.0	-2.0	2.5	-2.5	3.0	-2.0	0.5
-0.5	1.5	-2.0	2.0	-2.0	1.5	-1.0	1.0	-1.5	1.5
-2.0	2.0	-2.0	1.0	-1.0	1.5	-1.5	0.5	-0.5	1.5
-1.5	2.5	-1.5	-1.0	1.5	-1.5	2.0	-2.0		

AVE. VARIATION = -0.0DB STANDARD DEVIATION = 4.8

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-6.25	0.0
-5.75	0.0
-5.25	1.0
-4.75	1.0
-4.25	0.0
-3.75	0.0
-3.25	3.0
-2.75	2.0
-2.25	2.0
-1.75	15.0
-1.25	8.0
-0.75	9.0
-0.25	3.0
0.25	2.0
0.75	3.0
1.25	9.0
1.75	11.0
2.25	7.0
2.75	3.0
3.25	5.0
3.75	1.0
4.25	1.0
4.75	0.0
5.25	1.0
5.75	1.0
6.25	0.0

NEGATIVE VALUES MEAN	=	-1.92
POSITIVE VALUES MEAN	=	1.94
NEGATIVE VARIANCE	=	1.12
POSITIVE VARIANCE	=	1.26
NEGATIVE STANDARD DEVIATION	=	1.06
POSITIVE STANDARD DEVIATION	=	1.12



K-SCALE=5.00E+00 UNITS INCH.

K-SCALE=5.00E+00 UNITS INCH.

VARIATIONS RUNS7 ROLL05 PITCH00

COURSE 090 E&M DIR. 152 DIST 7.40.

VARIATIONS RUN57 ROLLO5 PITCH00
COURSE 090 E&M DIR. 152 DIST 7.48

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

6.00	1.000
5.50	0.989
5.00	0.966
4.50	0.955
4.00	0.943
3.50	0.932
3.00	0.841
2.50	0.784
2.00	0.682
1.50	0.386
1.00	0.193
0.50	0.057

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLOT	=	298 DEGREES RELATIVE
THETA OF PLOT	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	018 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
.9	.0	4.874
1.7	.0	1.450
2.5	.0	1.487
3.2	.0	2.803
3.8	.0	3.345
4.3	.0	2.842
4.6	.0	2.307
4.9	.0	2.045
4.9	.0	1.976
4.9	.0	2.045
4.6	.0	2.307
4.3	.0	2.842
3.8	.0	3.345
3.2	.0	2.803
2.5	.0	1.487
1.7	.0	1.450
.9	.0	4.874
-.9	.0	5.079
-1.7	.0	1.590
-2.5	.0	1.414
-3.2	.0	2.589
-3.8	.0	3.325
-4.3	.0	3.046
-4.6	.0	2.554
-4.9	.0	2.264
-4.9	.0	2.179
-4.9	.0	2.264
-4.6	.0	2.554
-4.3	.0	3.046
-3.8	.0	3.325
-3.2	.0	2.589
-2.5	.0	1.414
-1.7	.0	1.590
-.9	.0	5.079

AVERAGE VALUE = 2.65 DB

DISTRIBUTION RUN57AROLLJ5 PITCH00
COURSE 090 E&M DIR. 152 DIST 7.48

DATA POINTS

81.0	76.0	81.0	76.0	79.0	76.0	77.0	76.0	77.5
76.0	78.5	75.5	77.0	76.0	78.0	76.5	77.5	76.5
78.0	76.5	78.5	76.0	79.5	76.0	77.0	76.0	79.5
75.0	79.0	76.0	78.0	76.0	78.5	76.5	78.0	76.0
77.5	77.0	78.0	76.0	77.0	76.0	78.5	76.0	78.5
77.0	78.0	76.5						

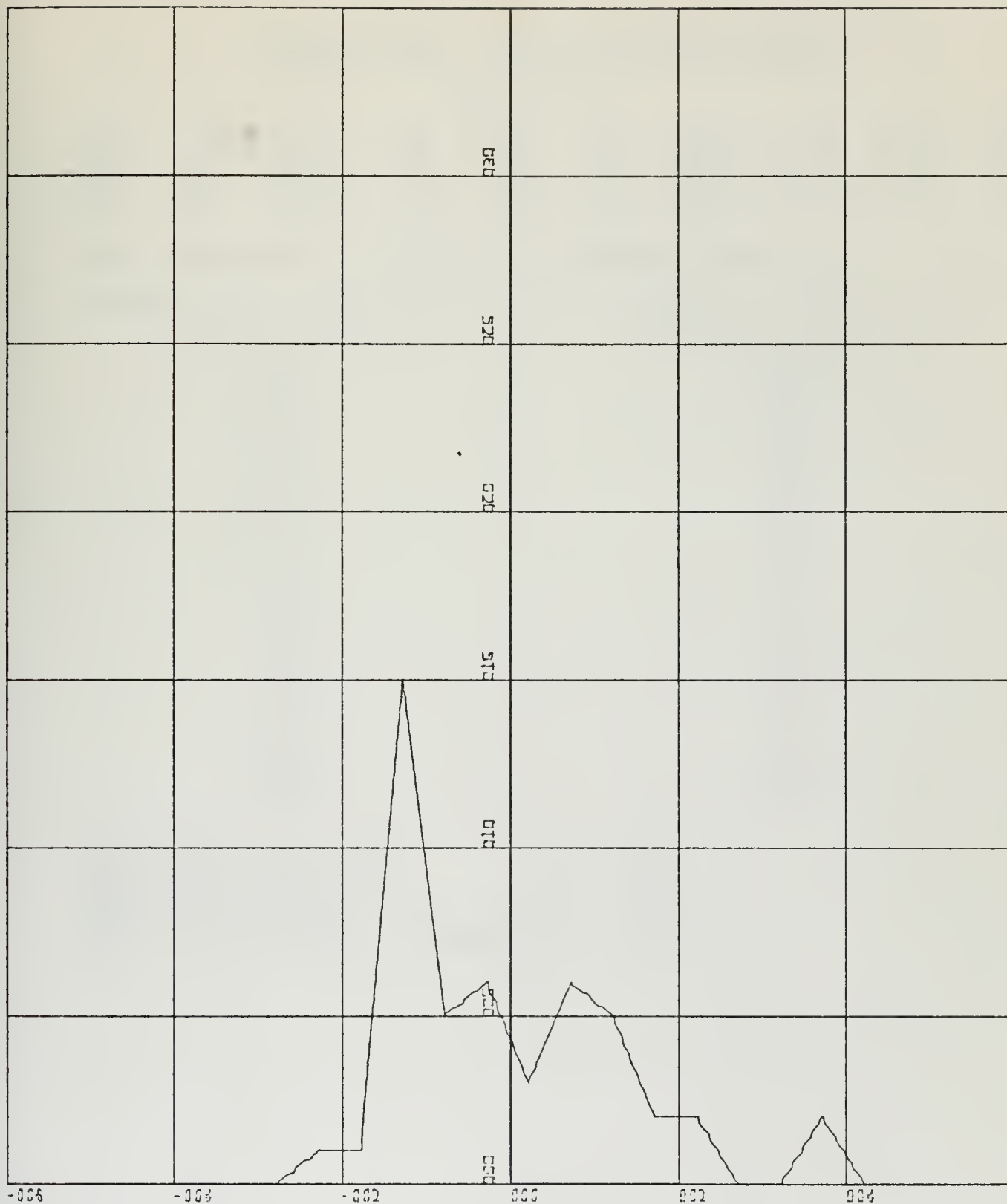
AVERAGE POWER = 77.2DB STANDARD DEVIATION = 1.9

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB POINTS AT THAT POWER

-4.25	0.0
-3.75	0.0
-3.25	0.0
-2.75	0.0
-2.25	1.0
-1.75	1.0
-1.25	15.0
-0.75	5.0
-0.25	6.0
0.25	3.0
0.75	6.0
1.25	5.0
1.75	2.0
2.25	2.0
2.75	0.0
3.25	0.0
3.75	2.0
4.25	0.0

NEGATIVE VALUES MEAN	=	-0.98
POSITIVE VALUES MEAN	=	1.37
NEGATIVE VARIANCE	=	0.25
POSITIVE VARIANCE	=	1.02
NEGATIVE STANDARD DEVIATION	=	0.50
POSITIVE STANDARD DEVIATION	=	1.01



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=5.00E+00 UNITS INCH.

DISTRIBUTION RUN57AROLL05 PITCH00

COURSE 090 E&M DIR. 152 DIST 7.48

VARIATIONS RUN57AROLL05 PITCH00
 COURSE 090 E&M DIR. 152 DIST 7.48

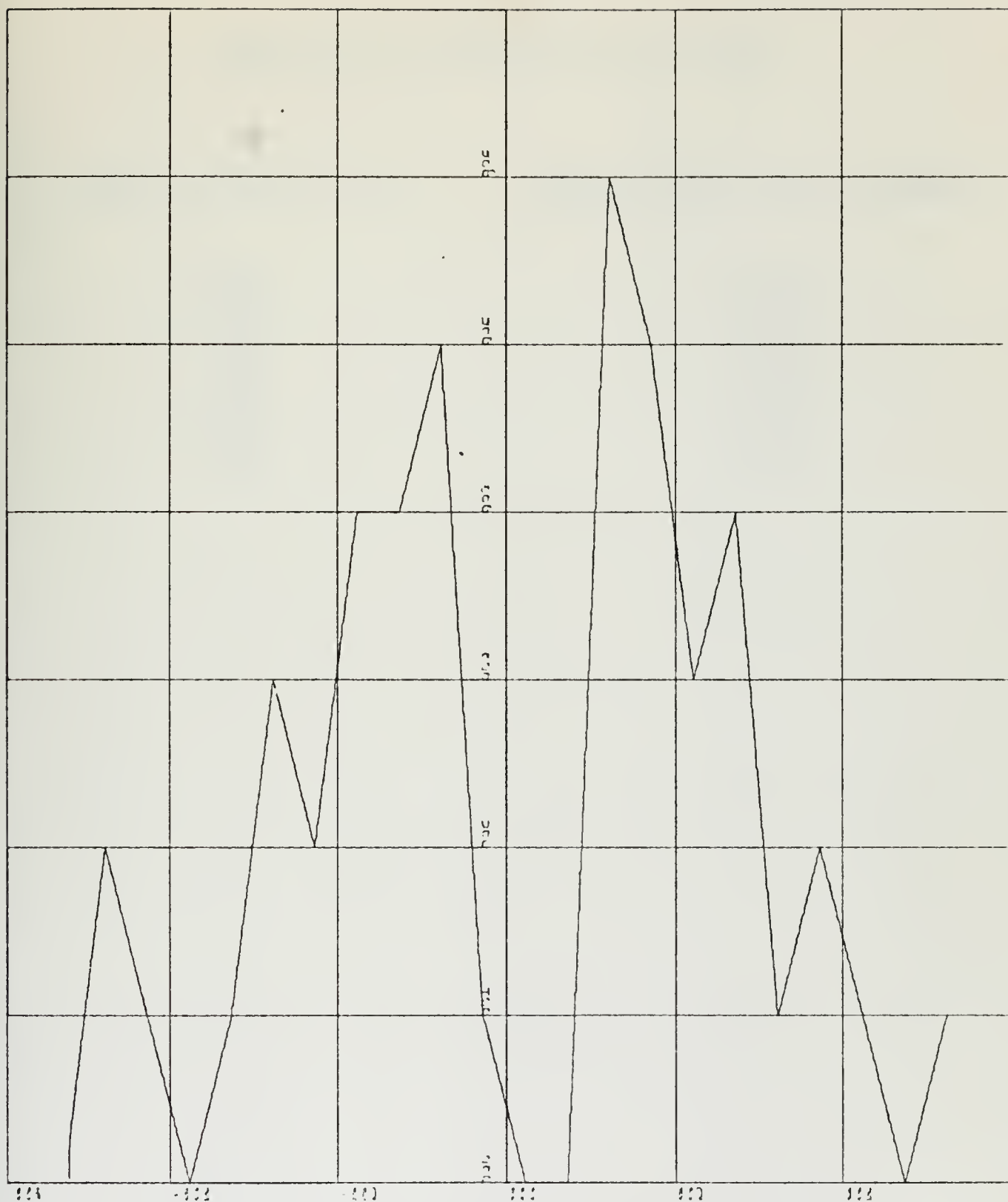
VARIATIONS									
-5.0	5.0	-5.0	3.0	-3.0	1.0	-1.0	1.5	-1.5	2.5
-3.0	1.5	-1.0	2.0	-1.5	1.0	-1.0	1.5	-1.5	2.0
-2.5	3.5	-3.5	1.0	-1.0	3.5	-4.5	4.0	-3.0	2.0
-2.0	2.5	-2.0	1.5	-2.0	1.5	-0.5	1.0	-2.0	1.0
-1.0	2.5	-2.5	2.5	-1.5	1.0				

AVE. VARIATION = -0.1DB STANDARD DEVIATION = 6.2

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-5.25	0.0
-4.75	2.0
-4.25	1.0
-3.75	0.0
-3.25	1.0
-2.75	3.0
-2.25	2.0
-1.75	4.0
-1.25	4.0
-0.75	5.0
-0.25	1.0
0.25	0.0
0.75	0.0
1.25	6.0
1.75	5.0
2.25	3.0
2.75	4.0
3.25	1.0
3.75	2.0
4.25	1.0
4.75	0.0
5.25	1.0

NEGATIVE VALUES MEAN	=	-2.24
POSITIVE VALUES MEAN	=	2.11
NEGATIVE VARIANCE	=	1.68
POSITIVE VARIANCE	=	1.20
NEGATIVE STANDARD DEVIATION	=	1.30
POSITIVE STANDARD DEVIATION	=	1.10



X-SCALE-2.00E+00 UNITS INCH.

Y-SCALE-1.00E+00 UNITS INCH.

VARIATIONS RUN57AROLL05 PITCH00

COURSE 090 E&M DIR. 152 DIST 7.40

VARIATIONS RUN57AROLL05 PITCH00
COURSE 090 E&M DIR. 152 DIST 7.48

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50

0.978
0.935
0.891
0.848
0.804
0.652
0.543
0.348
0.130
0.022

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95	METERS
HEIGHT OF ANTENNA	=	18.2	METERS
PHI OF ANTENNA	=	000	DEGREES RELATIVE
THETA OF ANTENNA	=	000	DEGREES RELATIVE
FREQUENCY	=	149.0	MHZ
EPSILON	=	80.0	
SIGMA	=	5.0	
PHI OF PLOT	=	298	DEGREES RELATIVE
THETA OF PLOT	=	089	DEGREES RELATIVE
SEA STATE	=	1	
DIRECTION OF SEA	=	090	DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
-------------------	--------------------	-------------------------

1.4	.0	2.157
2.7	.0	1.925
4.0	.0	3.204
5.1	.0	1.848
6.1	.0	2.276
6.9	.0	2.803
7.5	.0	2.532
7.9	.0	2.232
8.0	.0	2.139
7.9	.0	2.232
7.5	.0	2.532
6.9	.0	2.803
6.1	.0	2.276
5.1	.0	1.848
4.0	.0	3.204
2.7	.0	1.925
1.4	.0	2.157
-1.4	.0	2.347
-2.7	.0	1.775
-4.0	.0	3.296
-5.1	.0	1.995
-6.1	.0	2.100
-6.9	.0	2.741
-7.5	.0	2.725
-7.9	.0	2.486
-8.0	.0	2.391
-7.9	.0	2.486
-7.5	.0	2.725
-6.9	.0	2.741
-6.1	.0	2.100
-5.1	.0	1.995
-4.0	.0	3.296
-2.7	.0	1.775
-1.4	.0	2.347

AVERAGE VALUE = 2.39 DB

DISTRIBUTION RUN58 ROLLO8 PITCH00
 COURSE 090 E&M DIR. 152 DIST 7.48

DATA POINTS

75.5	77.0	76.0	77.0	75.0	77.5	75.0	77.5	75.5
76.5	75.5	78.0	75.0	77.0	75.0	77.0	75.5	77.0
75.5	78.0	75.5	78.0	76.0	78.5	75.5	76.5	75.5

AVERAGE POWER = 76.4DB STANDARD DEVIATION = 1.2

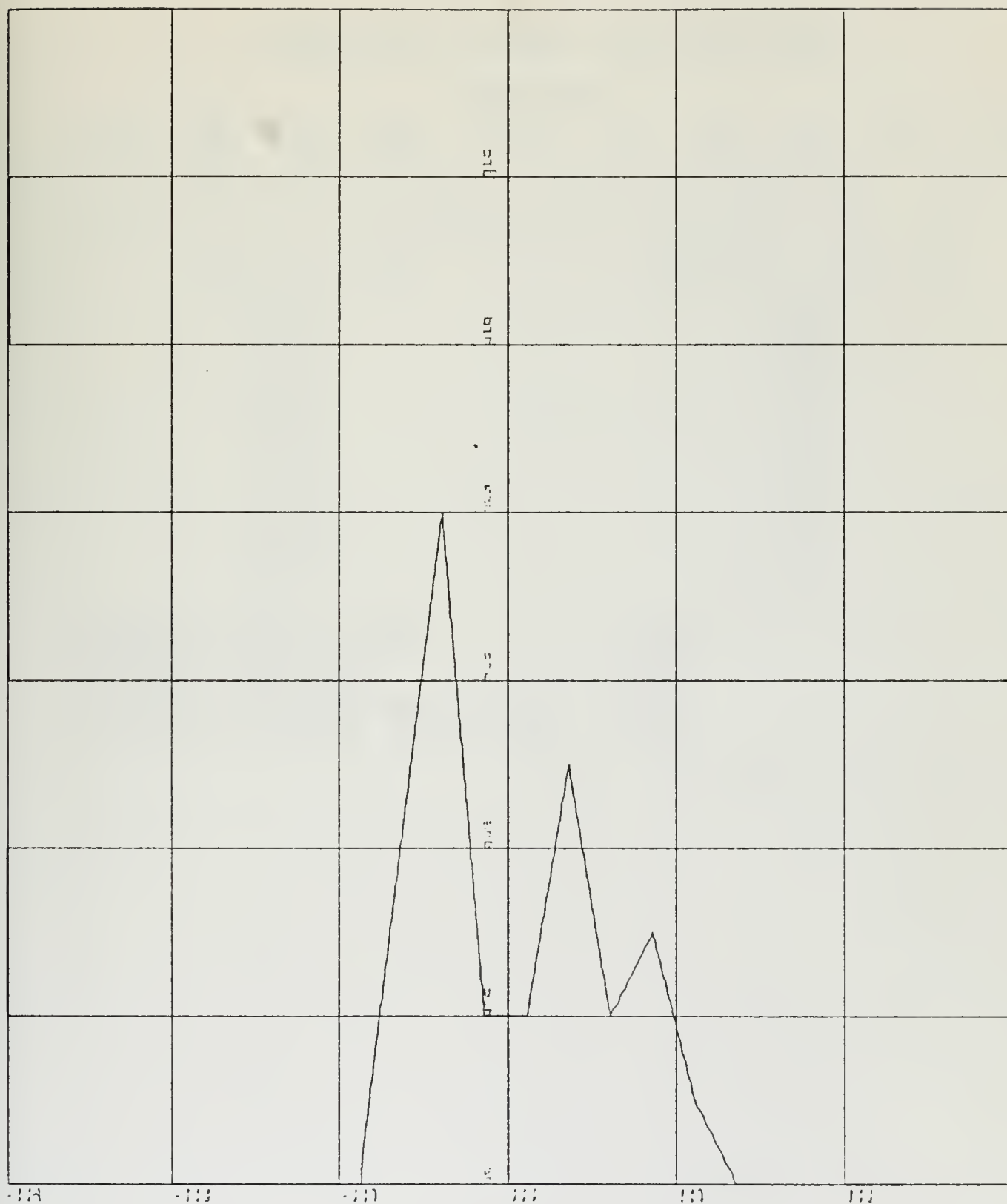
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	0.0
-1.25	4.0
-0.75	8.0
-0.25	2.0
0.25	2.0
0.75	5.0
1.25	2.0
1.75	3.0
2.25	1.0
2.75	0.0
3.25	0.0

NEGATIVE VALUES MEAN	=	-0.92
POSITIVE VALUES MEAN	=	0.99
NEGATIVE VARIANCE	=	0.11
POSITIVE VARIANCE	=	0.39
NEGATIVE STANDARD DEVIATION	=	0.33
POSITIVE STANDARD DEVIATION	=	0.63



K-SCALE=2.00E+00 UNITS INCH.
 Y-SCALE=2.00E+00 UNITS INCH.
 DISTRIBUTION RUNS0 ROLLO0 PITCH00
 COURSE 090 E&M DIR. 152 DIST 7.40

VARIATIONS RUN58 ROLL08 PITCH00
 COURSE 090 E&M DIR. 152 DIST 7.48

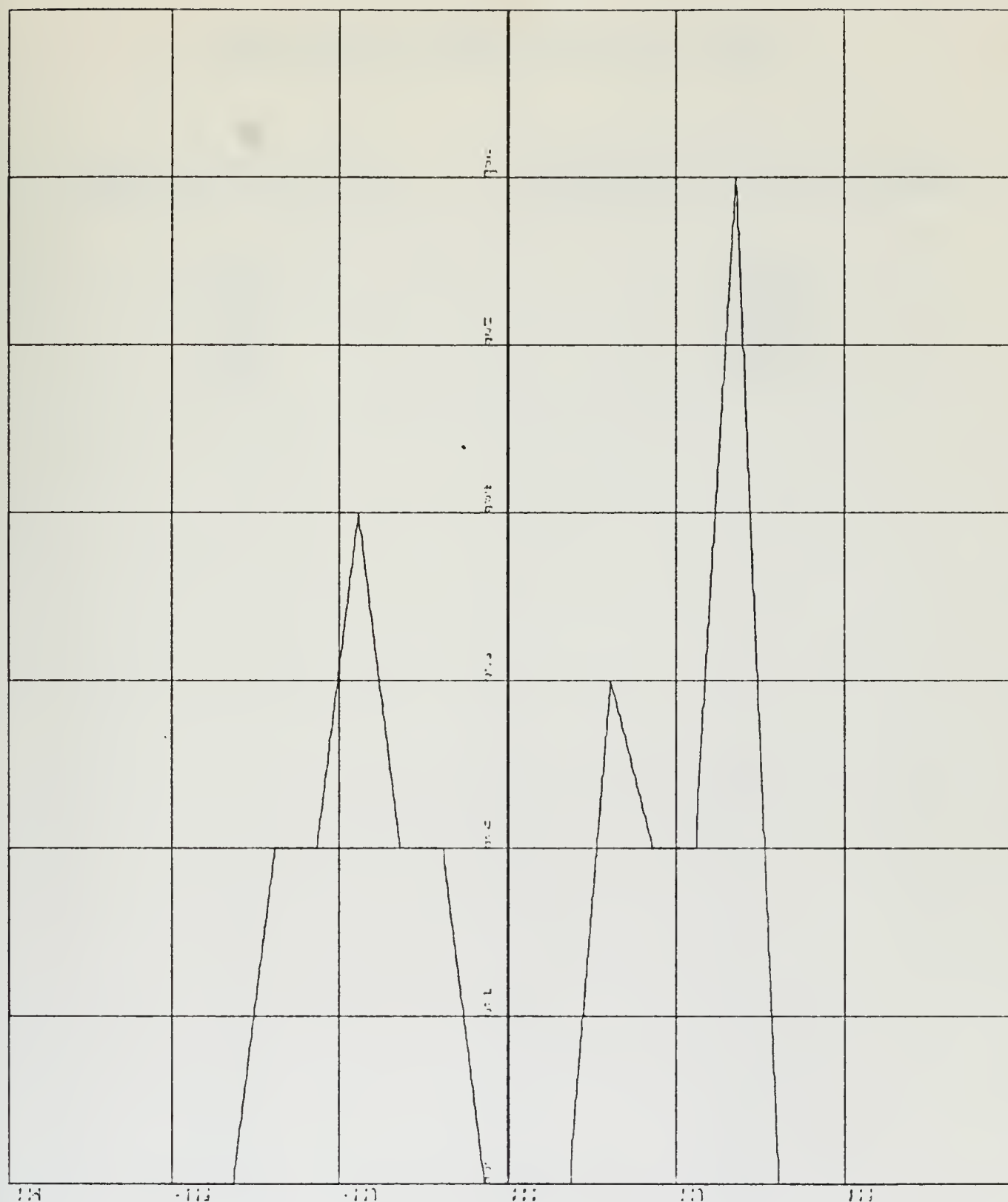
VARIATIONS
 1.5 -1.0 1.0 -2.0 2.5 -2.5 2.5 -2.0 1.0 -1.0
 2.5 -3.0 2.0 -2.0 2.0 -1.5 1.5 -1.5 2.5 -2.5
 2.5 -2.0 2.5 -3.0 1.0

AVE. VARIATION = 0.0DB STANDARD DEVIATION = 4.4

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-3.25	0.0
-2.75	2.0
-2.25	2.0
-1.75	4.0
-1.25	2.0
-0.75	2.0
-0.25	0.0
0.25	0.0
0.75	0.0
1.25	3.0
1.75	2.0
2.25	2.0
2.75	6.0
3.25	0.0

NEGATIVE VALUES MEAN	=	-2.00
POSITIVE VALUES MEAN	=	1.92
NEGATIVE VARIANCE	=	0.45
POSITIVE VARIANCE	=	0.41
NEGATIVE STANDARD DEVIATION	=	0.67
POSITIVE STANDARD DEVIATION	=	0.64



K-SCALE=2.00E+00 UNITS INCH.

V-SCALE=1.00E+00 UNITS INCH.

VARIATIONS RUN50 ROLL00 PITCH00

COURSE 090 E&M DIR. 152 DIST 7.40

VARIATIONS RUN58 ROLL08 PITCH00
COURSE 090 E&M DIR. 152 DIST 7.48

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

3.00
2.50
2.00
1.50
1.00
0.50

1.000
0.680
0.520
0.280
0.080
0.0

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PL0T	=	298 DEGREES RELATIVE
THETA OF PL0T	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	018 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
.9	.0	4.874
1.7	.0	1.450
2.5	.0	1.487
3.2	.0	2.803
3.8	.0	3.345
4.3	.0	2.842
4.6	.0	2.307
4.9	.0	2.045
4.9	.0	1.976
4.9	.0	2.045
4.6	.0	2.307
4.3	.0	2.842
3.8	.0	3.345
3.2	.0	2.803
2.5	.0	1.487
1.7	.0	1.450
.9	.0	4.874
-.9	.0	5.079
-1.7	.0	1.590
-2.5	.0	1.414
-3.2	.0	2.589
-3.8	.0	3.325
-4.3	.0	3.046
-4.6	.0	2.554
-4.9	.0	2.264
-4.9	.0	2.179
-4.9	.0	2.264
-4.6	.0	2.554
-4.3	.0	3.046
-3.8	.0	3.325
-3.2	.0	2.589
-2.5	.0	1.414
-1.7	.0	1.590
-.9	.0	5.079

AVERAGE VALUE = 2.65 DB

DISTRIBUTION RUN59 ROLL05 PITCH00
 COURSE 090 E&M DIR. 152 DIST 7.48

DATA POINTS

76.5	74.5	77.0	74.5	76.5	75.0	75.5	75.0	75.5
75.0	76.0	74.5	76.0	75.5	76.0	75.0	75.5	75.0
76.5	76.0	75.0	77.0	75.0	77.0	75.5		

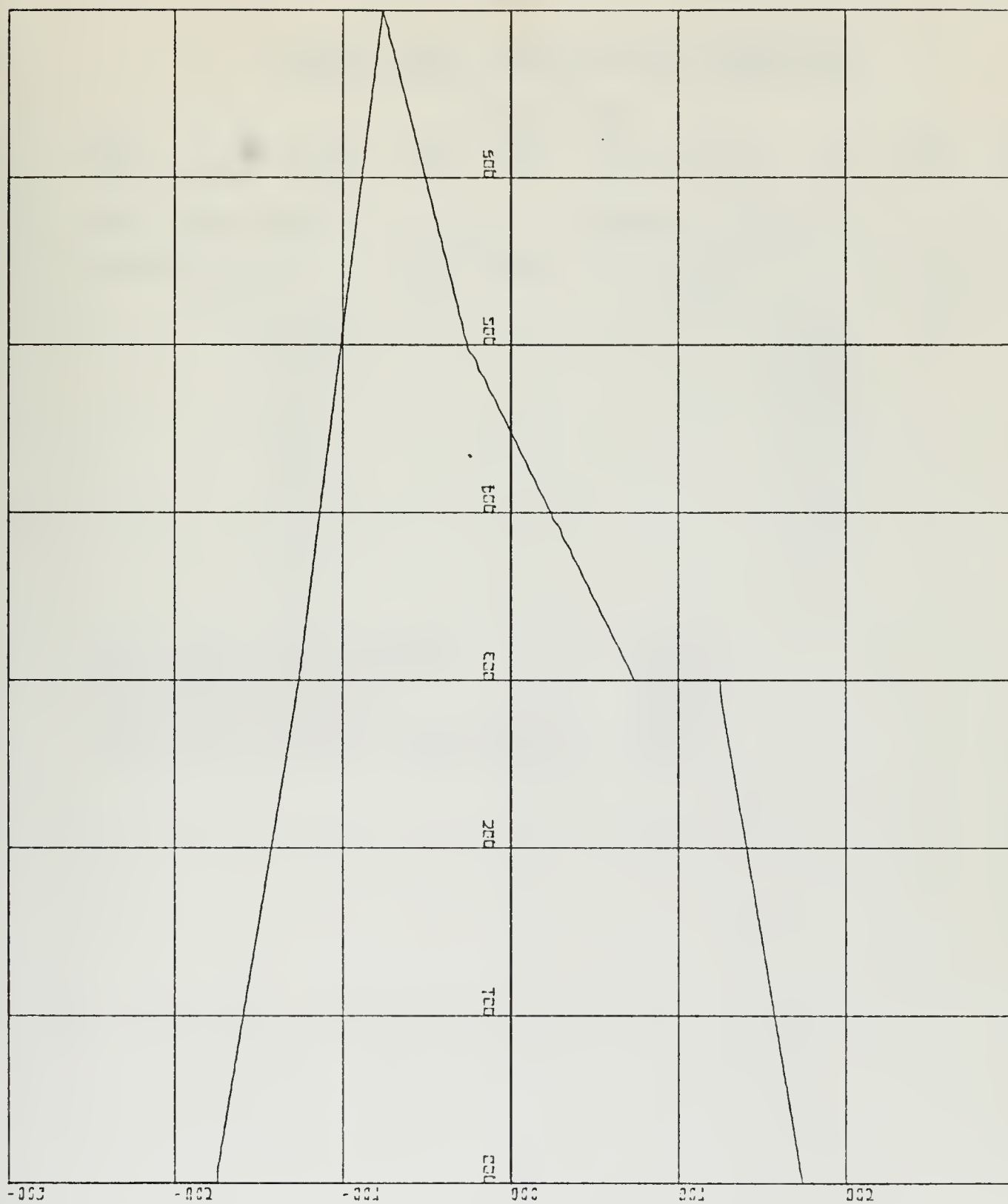
AVERAGE POWER = 75.6DB STANDARD DEVIATION = 0.6

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB	POINTS AT THAT POWER
----------------------	----------------------

-2.25	0.0
-1.75	0.0
-1.25	3.0
-0.75	7.0
-0.25	5.0
0.25	4.0
0.75	3.0
1.25	3.0
1.75	0.0
2.25	0.0

NEGATIVE VALUES MEAN	=	-0.55
POSITIVE VALUES MEAN	=	0.83
NEGATIVE VARIANCE	=	0.14
POSITIVE VARIANCE	=	0.19
NEGATIVE STANDARD DEVIATION	=	0.37
POSITIVE STANDARD DEVIATION	=	0.44



X-SCALE=1.00E+00 UNITS INCH.

Y-SCALE=1.00E+00 UNITS INCH.

DISTRIBUTION RUN59 ROLL05 PITCH00

COURSE 090 E&M DIR. 152 DIST 7.48

VARIATIONS RUN59 ROLL05 PITCH00
 COURSE 090 E&M DIR. 152 DIST 7.48

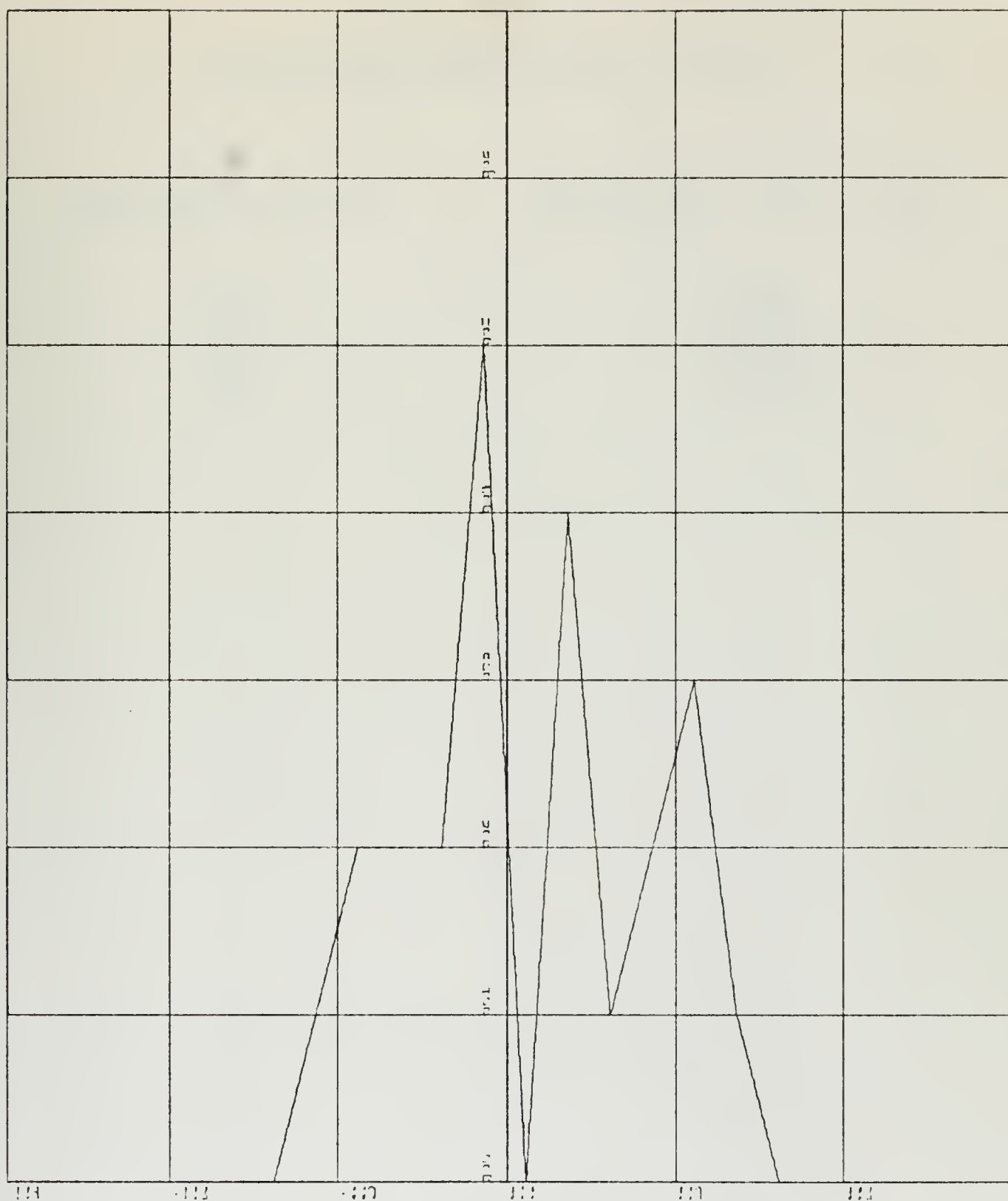
VARIATIONS
 -2.0 2.5 -2.5 2.0 -1.5 0.5 -0.5 0.5 -0.5 1.0
 -1.5 1.5 -0.5 0.5 -1.0 0.5 -0.5 1.5 -0.5 -1.0
 2.0 -2.0 2.0

AVE. VARIATION = 0.0DB STANDARD DEVIATION = 2.1

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-3.25	0.0
-2.75	0.0
-2.25	1.0
-1.75	2.0
-1.25	2.0
-0.75	2.0
-0.25	5.0
0.25	0.0
0.75	4.0
1.25	1.0
1.75	2.0
2.25	3.0
2.75	1.0
3.25	0.0

NEGATIVE VALUES MEAN	=	-1.17
POSITIVE VALUES MEAN	=	1.32
NEGATIVE VARIANCE	=	0.52
POSITIVE VARIANCE	=	0.56
NEGATIVE STANDARD DEVIATION	=	0.72
POSITIVE STANDARD DEVIATION	=	0.75



K-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=1.00E+00 UNITS INCH.

VARIATIONS RUN59 ROLLO5 PITCH00

COURSE 090 E&M DIR. 152 DIST 7.40

VARIATIONS RUN59 ROLL05 PITCH00
COURSE 090 E&M DIR. 152 DIST 7.48

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

3.00
2.50
2.00
1.50
1.00
0.50

1.000
0.957
0.783
0.609
0.478
0.217

ANTENNA SIMULATION

LENGTH OF ANTENNA = .95 METERS
 HEIGHT OF ANTENNA = 18.2 METERS
 PHI OF ANTENNA = 000 DEGREES RELATIVE
 THETA OF ANTENNA = 000 DEGREES RELATIVE
 FREQUENCY = 149.0 MHZ
 EPSILON = 80.0
 SIGMA = 5.0
 PHI OF PLOT = 208 DEGREES RELATIVE
 THETA OF PLOT = 089 DEGREES RELATIVE
 SEA STATE = 2
 DIRECTION OF SEA = 030 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
1.4	.8	2.162
2.7	1.6	1.939
4.0	2.4	3.240
5.1	3.1	1.903
6.1	3.7	2.335
6.9	4.2	2.892
7.5	4.5	2.657
7.9	4.7	2.369
8.0	4.8	2.279
7.9	4.7	2.369
7.5	4.5	2.657
6.9	4.2	2.892
6.1	3.7	2.335
5.1	3.1	1.903
4.0	2.4	3.240
2.7	1.6	1.939
1.4	.8	2.162
-1.4	-.8	2.350
-2.7	-1.6	1.784
-4.0	-2.4	3.322
-5.1	-3.1	2.042
-6.1	-3.7	2.148
-6.9	-4.2	2.808
-7.5	-4.5	2.827
-7.9	-4.7	2.607
-8.0	-4.8	2.517
-7.9	-4.7	2.607
-7.5	-4.5	2.827
-6.9	-4.2	2.808
-6.1	-3.7	2.148
-5.1	-3.1	2.042
-4.0	-2.4	3.322
-2.7	-1.6	1.784
-1.4	-.8	2.350

AVERAGE VALUE = 2.46 DB

DISTRIBUTION RUN60 ROLL08 PITCH06
COURSE 000 E&M DIR. 152 DIST 7.48

DATA POINTS

77.5	76.5	77.0	75.5	79.0	76.0	78.0	76.5	79.0
76.0	78.5	76.0	79.0	76.0	78.5	76.0	79.0	76.0
77.5	75.0	79.5	76.0	77.5	75.5	79.0	76.0	78.0
75.0	79.5	76.5	78.0	75.5	77.0	76.0	79.0	75.0
78.0	75.0	76.5	76.0	77.5	79.0	75.5	77.5	76.0
76.5	77.0	75.5	77.5	75.5	77.0	76.0	77.0	75.5
78.5	76.0	77.0	75.5	76.5	75.5	76.5	75.0	76.5
75.5	77.0	78.0	76.0	75.5	77.0	76.0	76.5	75.0
76.5	76.5	76.0	77.5	75.5	77.0	75.5	77.0	74.5
77.5	75.0	76.0	74.5	76.0	74.5	76.5	74.0	75.0

AVERAGE POWER = 76.6DB

STANDARD DEVIATION = 1.7

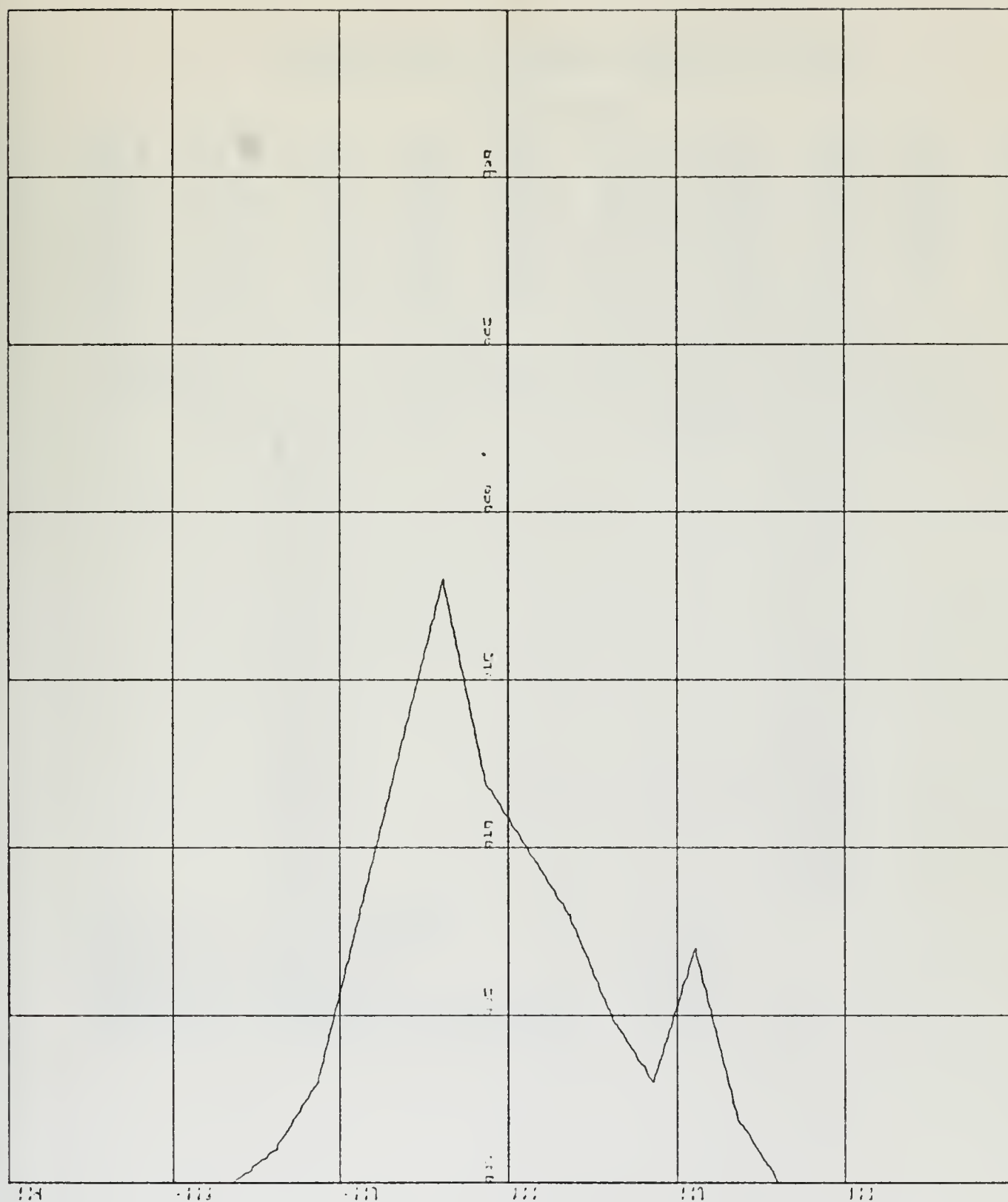
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-3.25	0.0
-2.75	1.0
-2.25	3.0
-1.75	8.0
-1.25	13.0
-0.75	18.0
-0.25	12.0
0.25	10.0
0.75	8.0
1.25	5.0
1.75	3.0
2.25	7.0
2.75	2.0
3.25	0.0

NEGATIVE VALUES MEAN	=	-0.86
POSITIVE VALUES MEAN	=	1.35
NEGATIVE VARIANCE	=	0.39
POSITIVE VARIANCE	=	0.71
NEGATIVE STANDARD DEVIATION	=	0.62
POSITIVE STANDARD DEVIATION	=	0.84



K-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=5.00E+00 UNITS INCH.

DISTRIBUTION RUN60 ROLLOFF PITCH06

COURSE 000 E&M DIR. 152 DIST 7.40

VARIATIONS RUN60 ROLL08 PITCH06
 COURSE 000 E&M DIR. 152 DIST 7.48

				VARIATIONS							
-1.0	0.5	-1.5	3.5	-3.0	2.0	-1.5	2.5	-3.0	2.5		
-2.5	3.0	-3.0	2.5	-2.5	3.0	-3.0	1.5	-2.5	4.5		
-3.5	1.5	-2.0	3.5	-3.0	2.0	-3.0	4.5	-3.0	1.5		
-2.5	1.5	-1.0	3.0	-4.0	3.0	-3.0	1.5	-0.5	1.5		
1.5	-3.5	2.0	-1.5	0.5	0.5	-1.5	2.0	-2.0	1.5		
-1.0	1.0	-1.5	3.0	-2.5	1.0	-1.5	1.0	-1.0	1.0		
-1.5	1.5	-1.0	1.5	1.0	-2.0	-0.5	1.5	-1.0	0.5		
-1.5	1.5	0.0	-0.5	1.5	-2.0	1.5	-1.5	1.5	-2.5		
3.0	-2.5	1.0	-1.5	1.5	-1.5	2.0	-2.5				

AVE. VARIATION = -0.0DB STANDARD DEVIATION = 4.7

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-5.25	0.0
-4.75	0.0
-4.25	0.0
-3.75	1.0
-3.25	2.0
-2.75	8.0
-2.25	8.0
-1.75	4.0
-1.25	11.0
-0.75	6.0
-0.25	3.0
0.25	1.0
0.75	4.0
1.25	6.0
1.75	16.0
2.25	5.0
2.75	3.0
3.25	6.0
3.75	2.0
4.25	0.0
4.75	2.0
5.25	0.0

NEGATIVE VALUES MEAN	=	-2.02
POSITIVE VALUES MEAN	=	1.90
NEGATIVE VARIANCE	=	0.81
POSITIVE VARIANCE	=	0.98
NEGATIVE STANDARD DEVIATION	=	0.90
POSITIVE STANDARD DEVIATION	=	0.99



K-SCALE=2.00E+00 UNITS INCH.

V-SCALE=5.00E+00 UNITS INCH.

VARIATIONS RUN60 ROLLOFF PITCH06

COURSE 000 E&M DIR. 152 DIST 7.40

VARIATIONS RUN60 ROLLO8 PITCH06
COURSE 000 E&M DIR. 152 DIST 7.48

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

5.00	1.000
4.50	0.977
4.00	0.977
3.50	0.943
3.00	0.852
2.50	0.727
2.00	0.580
1.50	0.352
1.00	0.159
0.50	0.045

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLOT	=	298 DEGREES RELATIVE
THETA OF PLOT	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	018 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
.9	.0	4.874
1.7	.0	1.450
2.5	.0	1.487
3.2	.0	2.803
3.8	.0	3.345
4.3	.0	2.842
4.6	.0	2.307
4.9	.0	2.045
4.9	.0	1.976
4.9	.0	2.045
4.6	.0	2.307
4.3	.0	2.842
3.8	.0	3.345
3.2	.0	2.803
2.5	.0	1.487
1.7	.0	1.450
.9	.0	4.874
-.9	.0	5.079
-1.7	.0	1.590
-2.5	.0	1.414
-3.2	.0	2.589
-3.8	.0	3.325
-4.3	.0	3.046
-4.6	.0	2.554
-4.9	.0	2.264
-4.9	.0	2.179
-4.9	.0	2.264
-4.6	.0	2.554
-4.3	.0	3.046
-3.8	.0	3.325
-3.2	.0	2.589
-2.5	.0	1.414
-1.7	.0	1.590
-.9	.0	5.079

AVERAGE VALUE = 2.65 DB

DISTRIBUTION RUN61 ROLL05 PITCH00
COURSE 090 E&M DIR. 152 DIST 7.48

DATA POINTS

76.0	75.0	76.0	74.0	75.0	74.5	76.5	75.0	76.0
74.0	75.0	74.0	76.5	74.5	76.0	74.0	75.0	76.5
74.5	76.5	74.0	76.0	74.5	75.5	74.0	76.0	74.0
75.0	74.0	75.0	74.0	75.0	74.0	75.5	74.0	75.5
74.5	75.5	74.5	75.0	73.5	75.0	74.0	75.0	74.0
75.0	74.0	75.0	74.0	75.0	74.0	75.0	74.0	75.0
74.0	75.0	74.0	73.0	74.0				

AVERAGE POWER = 74.8DB STANDARD DEVIATION = 0.7

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-2.25	0.0
-1.75	1.0
-1.25	1.0
-0.75	20.0
-0.25	6.0
0.25	17.0
0.75	4.0
1.25	6.0
1.75	4.0
2.25	0.0

NEGATIVE VALUES MEAN	=	-0.73
POSITIVE VALUES MEAN	=	0.66
NEGATIVE VARIANCE	=	0.10
POSITIVE VARIANCE	=	0.32
NEGATIVE STANDARD DEVIATION	=	0.31
POSITIVE STANDARD DEVIATION	=	0.57



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=5.00E+00 UNITS INCH.

DISTRIBUTION RUN61 ROLLOS PITCH00

COURSE 090 E&M DIR. 152 DIST 7.48

VARIATIONS RUN61 ROLL05 PITCH00
COURSE 090 E&M DIR. 152 DIST 7.48

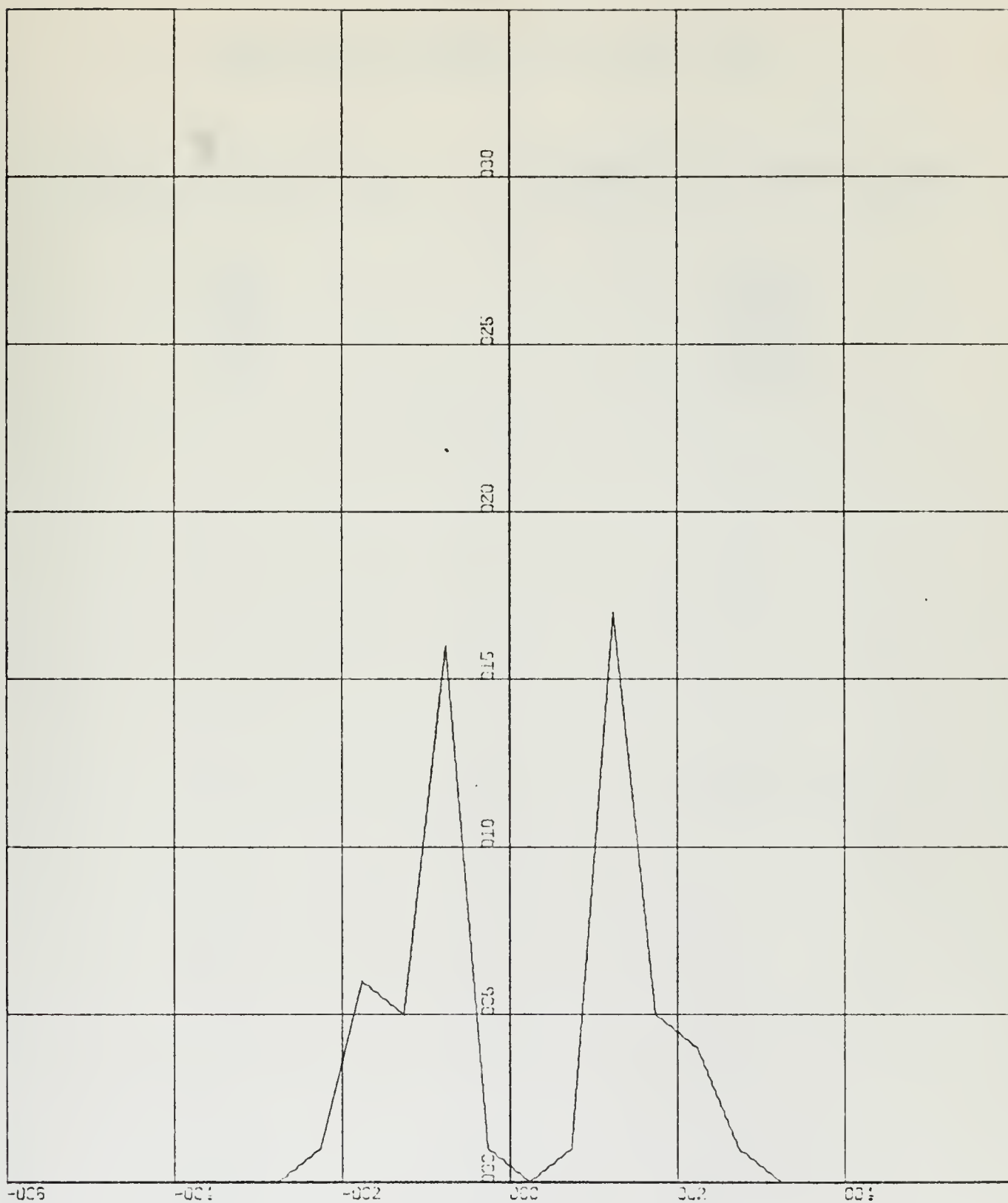
				VARIATIONS					
-1.0	1.0	-2.0	1.0	-0.5	2.0	-1.5	1.0	-2.0	1.0
-1.0	2.5	-2.0	1.5	-2.0	1.0	1.5	-2.0	2.0	-2.5
2.0	-1.5	1.0	-1.5	2.0	-2.0	1.0	-1.0	1.0	-1.0
1.0	-1.0	1.5	-1.5	1.5	-1.0	1.0	-1.0	0.5	-1.5
1.5	-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0
1.0	-1.0	1.0	-1.0	1.0	-1.0	-1.0			

AVE. VARIATION = -0.1DB STANDARD DEVIATION = 1.9

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-3.25	0.0
-2.75	0.0
-2.25	1.0
-1.75	6.0
-1.25	5.0
-0.75	16.0
-0.25	1.0
0.25	0.0
0.75	1.0
1.25	17.0
1.75	5.0
2.25	4.0
2.75	1.0
3.25	0.0

NEGATIVE VALUES MEAN	=	-1.33
POSITIVE VALUES MEAN	=	1.27
NEGATIVE VARIANCE	=	0.24
POSITIVE VARIANCE	=	0.21
NEGATIVE STANDARD DEVIATION	=	0.49
POSITIVE STANDARD DEVIATION	=	0.46

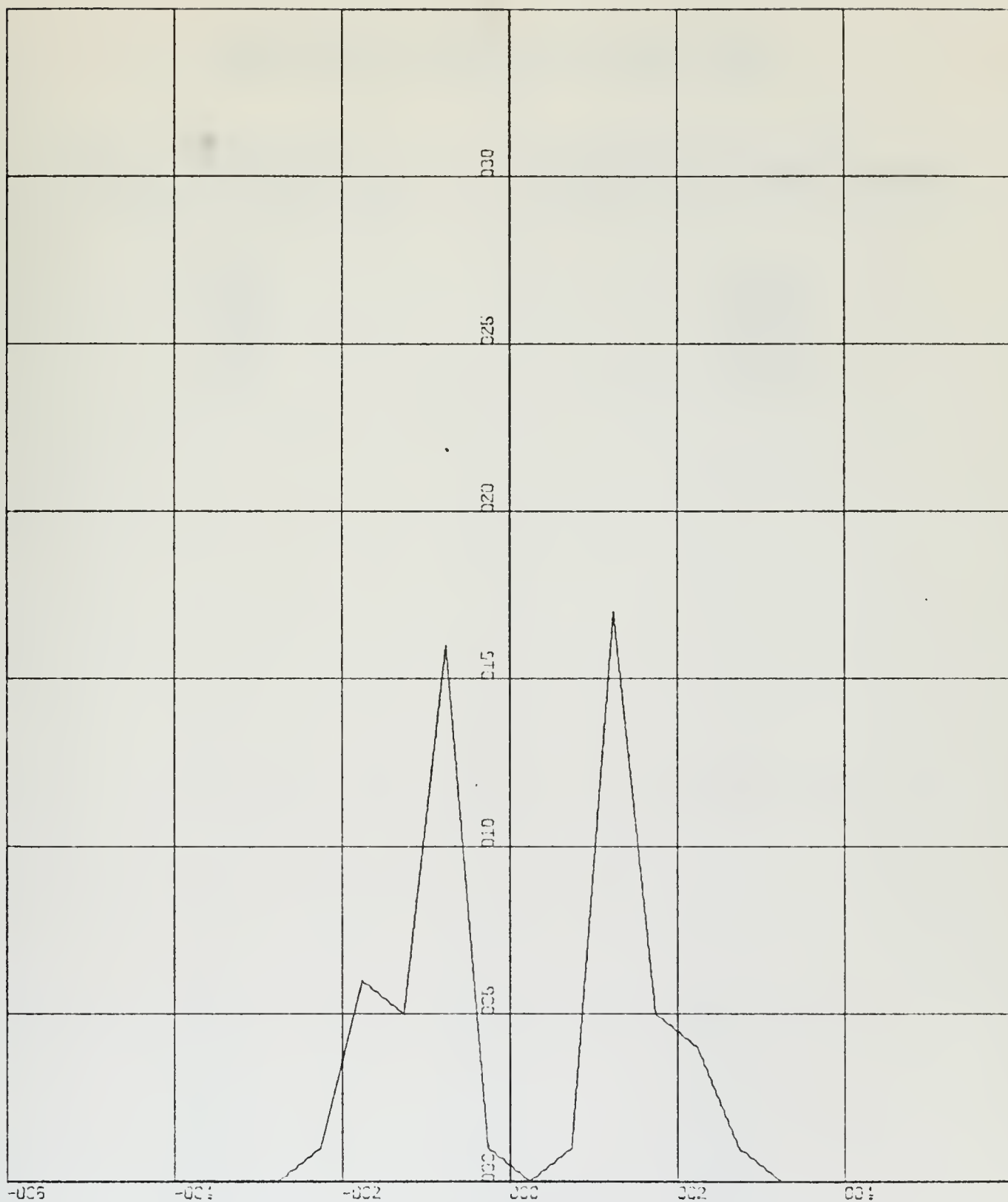


X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=5.00E+00 UNITS INCH.

VARIATIONS RUN61 ROLL05 PITCH00

COURSE 090 E&M DIR. 152 DIST 7.48



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=5.00E+00 UNITS INCH.

VARIATIONS RUN61 ROLL05 PITCH00

COURSE 090 E&M DIR. 152 DIST 7.48

VARIATIONS RUN61 ROLLO5 PITCH00
COURSE 090 E&M DIR. 152 DIST 7.48

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

3.00
2.50
2.00
1.50
1.00
0.50

1.000
0.982
0.895
0.702
0.316
0.018

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLOT	=	010 DEGREES RELATIVE
THETA OF PLOT	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	070 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
2.6	.0	1.727
5.1	.0	1.940
7.5	.0	2.718
9.7	.0	2.638
11.5	.0	2.355
13.0	.0	2.634
14.1	.0	2.719
14.8	.0	2.504
15.0	.0	2.448
14.8	.0	2.504
14.1	.0	2.719
13.0	.0	2.634
11.5	.0	2.355
9.7	.0	2.638
7.5	.0	2.718
5.1	.0	1.940
2.6	.0	1.727
-2.6	.0	1.598
-5.1	.0	2.060
-7.5	.0	2.873
-9.7	.0	2.415
-11.5	.0	2.538
-13.0	.0	2.424
-14.1	.0	2.766
-14.8	.0	2.685
-15.0	.0	2.618
-14.8	.0	2.685
-14.1	.0	2.766
-13.0	.0	2.424
-11.5	.0	2.538
-9.7	.0	2.415
-7.5	.0	2.873
-5.1	.0	2.060
-2.6	.0	1.598

AVERAGE VALUE = 2.42 DB

DISTRIBUTION RUN62 ROLL15 PITCH00
 COURSE 160 E&M DIR. 150 DIST 6.30

DATA POINTS

74.5	75.5	73.5	75.0	73.5	74.0	75.0	73.5	74.5
73.5	74.0	74.5	74.0	74.5	73.5	75.0	73.5	74.0
73.5	74.5	73.5	75.0	73.5	77.5	76.5	78.0	73.5
75.0	74.0	74.5	74.0					

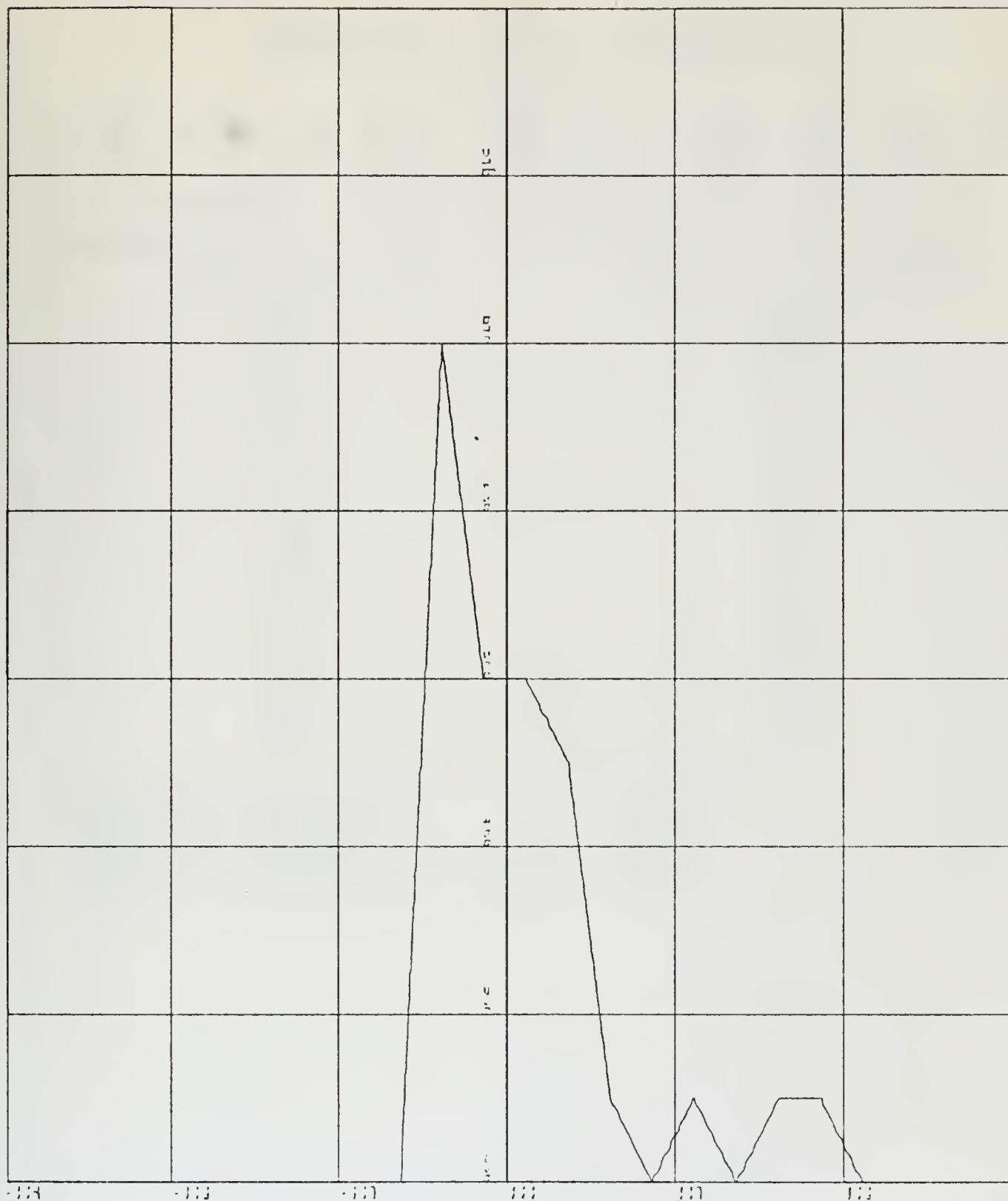
AVERAGE POWER = 74.5DB STANDARD DEVIATION = 1.3

GRAPHED DATA IS, NGRMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB	POINTS AT THAT POWER
----------------------	----------------------

-4.25	0.0
-3.75	0.0
-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	0.0
-1.25	0.0
-0.75	10.0
-0.25	6.0
0.25	6.0
0.75	5.0
1.25	1.0
1.75	0.0
2.25	1.0
2.75	0.0
3.25	1.0
3.75	1.0
4.25	0.0

NEGATIVE VALUES MEAN	=	-0.78
POSITIVE VALUES MEAN	=	0.83
NEGATIVE VARIANCE	=	0.06
POSITIVE VARIANCE	=	1.28
NEGATIVE STANDARD DEVIATION	=	0.25
POSITIVE STANDARD DEVIATION	=	1.13



K-SCALE=2.00E+00 UNITS INCH.

V-SCALE=2.00E+00 UNITS INCH.

DISTRIBUTION RUN62 ROLL15 PITCH00

COURSE 160 E&M DIR. 150 DIST 6.30

VARIATIONS RUN62 ROLL15 PITCH00
 COURSE 160 E&M DIR. 150 DIST 6.30

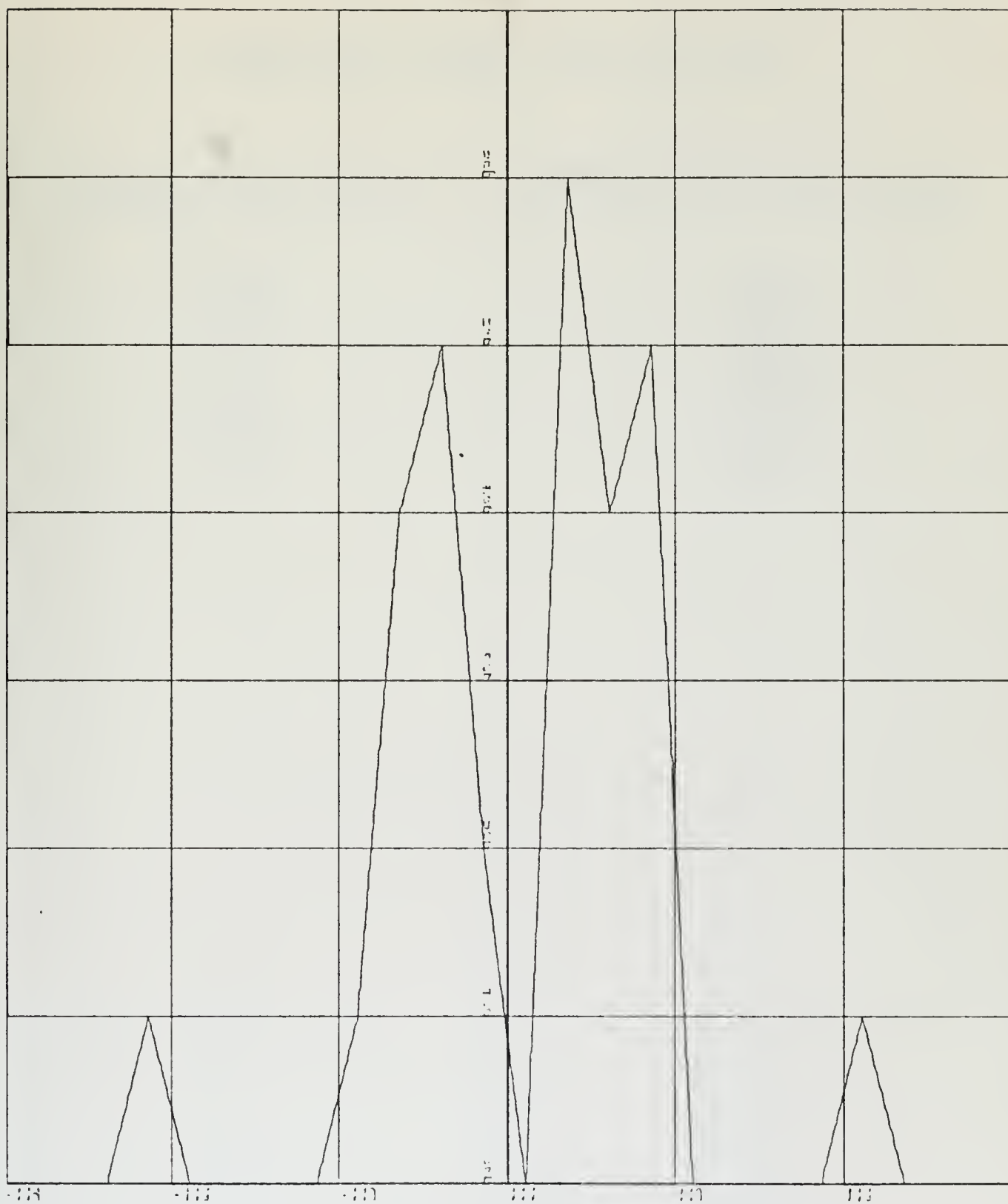
VARIATIONS
 1.0 -2.0 1.5 -1.5 0.5 1.0 -1.5 1.0 -1.0 0.5
 0.5 -0.5 0.5 -1.0 1.5 -1.5 0.5 -0.5 1.0 -1.0
 1.5 -1.5 4.0 -1.0 1.5 -4.5 1.5 -1.0 0.5

AVE. VARIATION = -0.0DB STANDARD DEVIATION = 2.6

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-5.25	0.0
-4.75	0.0
-4.25	1.0
-3.75	0.0
-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	1.0
-1.25	4.0
-0.75	5.0
-0.25	2.0
0.25	0.0
0.75	6.0
1.25	4.0
1.75	5.0
2.25	0.0
2.75	0.0
3.25	0.0
3.75	0.0
4.25	1.0
4.75	0.0
5.25	0.0

NEGATIVE VALUES MEAN	=	-1.42
POSITIVE VALUES MEAN	=	1.16
NEGATIVE VARIANCE	=	1.04
POSITIVE VARIANCE	=	0.76
NEGATIVE STANDARD DEVIATION	=	1.02
POSITIVE STANDARD DEVIATION	=	0.87



K-SCALE=2.00E+00 UNITS INCH.

K-SCALE=1.00E+00 UNITS INCH.

VARIATIONS RUN62 ROLL15 PITCH00

COURSE 160 E&M DIR. 150 DIST 6.30

VARIATIONS RUN62 ROLL15 PITCH00
COURSE 160 E&M DIR. 150 DIST 6.30

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

5.00	1.000
4.50	1.000
4.00	0.931
3.50	0.931
3.00	0.931
2.50	0.931
2.00	0.931
1.50	0.724
1.00	0.448
0.50	0.069

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLOT	=	306 DEGREES RELATIVE
THETA OF PLOT	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	018 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
-------------------	--------------------	-------------------------

.9	.0	4.875
1.7	.0	1.452
2.5	.0	1.490
3.2	.0	2.809
3.8	.0	3.353
4.3	.0	2.852
4.6	.0	2.319
4.9	.0	2.058
4.9	.0	1.989
4.9	.0	2.058
4.6	.0	2.319
4.3	.0	2.852
3.8	.0	3.353
3.2	.0	2.809
2.5	.0	1.490
1.7	.0	1.452
.9	.0	4.875
-.9	.0	5.080
-1.7	.0	1.592
-2.5	.0	1.416
-3.2	.0	2.594
-3.8	.0	3.332
-4.3	.0	3.054
-4.6	.0	2.564
-4.9	.0	2.275
-4.9	.0	2.190
-4.9	.0	2.275
-4.6	.0	2.564
-4.3	.0	3.054
-3.8	.0	3.332
-3.2	.0	2.594
-2.5	.0	1.416
-1.7	.0	1.592
-.9	.0	5.080

AVERAGE VALUE = 2.66 DB

DISTRIBUTION RUN66 ROLL05 PITCH00
COURSE 090 E&M DIR. 144 DIST 4.17

DATA POINTS

72.5	73.5	73.0	73.5	73.0	77.5	73.5	74.0	72.5
72.0	74.0	74.5	72.0	75.0	72.5	74.5	72.5	75.0
72.5	74.5	72.5	74.0	72.0	74.5	72.0	74.0	72.0
75.0	72.5	74.0	72.5	74.5	73.0	75.0	72.0	75.0
72.0	73.5	72.0	74.5	73.5	74.5	73.0	73.5	73.0
75.5	72.0	76.0	73.0	76.5	72.5	73.5	72.5	73.5
72.5	74.5	73.0	74.0	72.5	73.0	72.0	74.0	73.0
74.5	73.0	75.0	73.0	74.5	73.5	74.0	73.5	74.0
73.0	75.0	73.0	75.5	74.5	76.0			

AVERAGE POWER = 73.6DB

STANDARD DEVIATION = 1.4

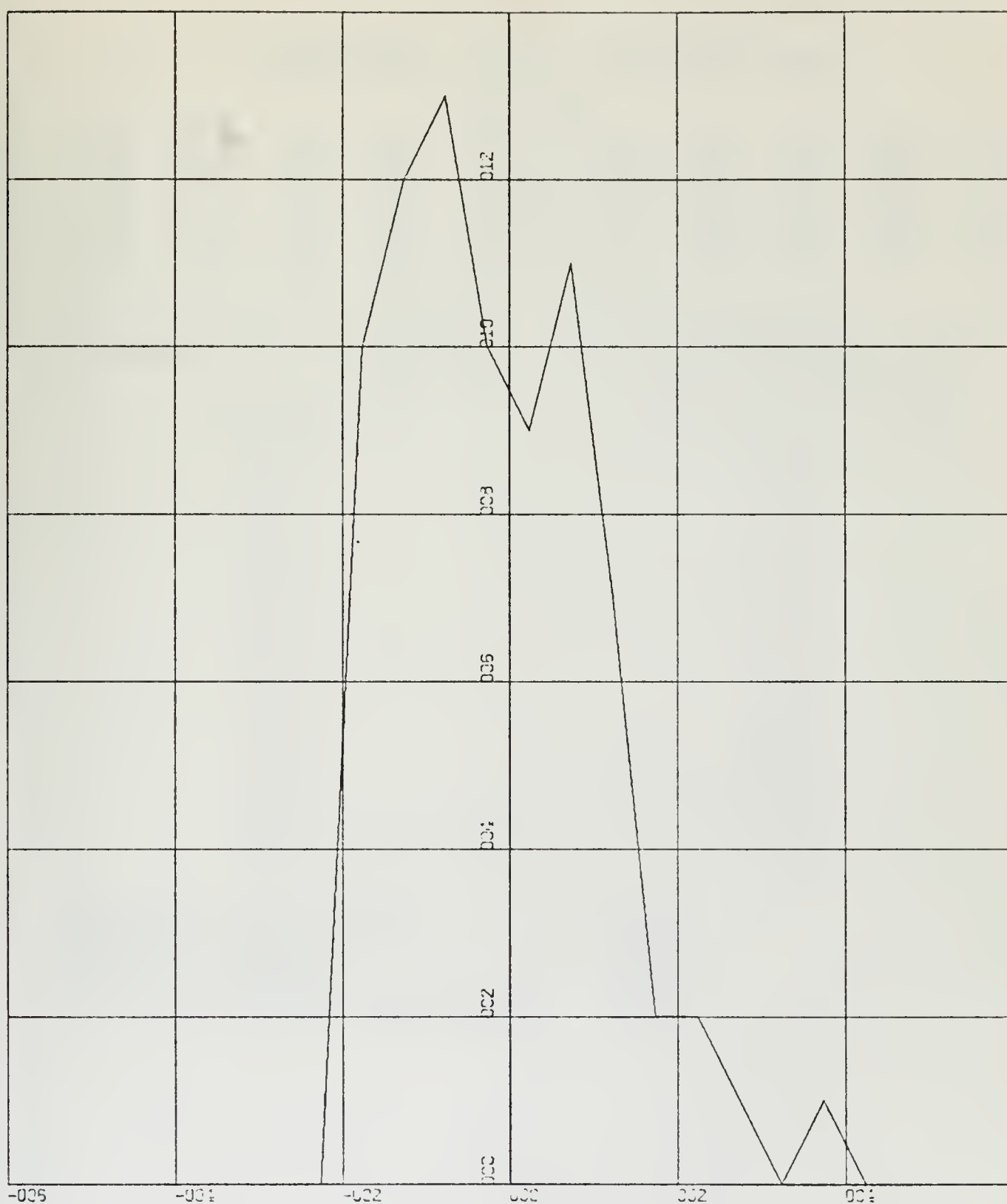
GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB

POINTS AT THAT POWER

-4.25	0.0
-3.75	0.0
-3.25	0.0
-2.75	0.0
-2.25	0.0
-1.75	10.0
-1.25	12.0
-0.75	13.0
-0.25	10.0
0.25	9.0
0.75	11.0
1.25	7.0
1.75	2.0
2.25	2.0
2.75	1.0
3.25	0.0
3.75	1.0
4.25	0.0

NEGATIVE VALUES MEAN	=	-0.85
POSITIVE VALUES MEAN	=	1.16
NEGATIVE VARIANCE	=	0.29
POSITIVE VARIANCE	=	0.66
NEGATIVE STANDARD DEVIATION	=	0.54
POSITIVE STANDARD DEVIATION	=	0.81



X-SCALE=-2.00E+00 UNITS INCH.

Y-SCALE=-2.00E+00 UNITS INCH.

DISTRIBUTION RUN66 ROLL05 PITCH00

COURSE 090 E&M DIR. 144 DIST 4.17

VARIATIONS RUN66 ROLL05 PITCH00
COURSE 090 E&M DIR. 144 DIST 4.17

VARIATIONS									
1.0	-0.5	0.5	-0.5	4.5	-4.0	0.5	-1.5	-0.5	2.0
0.5	-2.5	3.0	-2.5	2.0	-2.0	2.5	-2.5	2.0	-2.0
1.5	-2.0	2.5	-2.5	2.0	-2.0	3.0	-2.5	1.5	-1.5
2.0	-1.5	2.0	-3.0	3.0	-3.0	1.5	-1.5	2.5	-1.0
1.0	-1.5	0.5	-0.5	2.5	-3.5	4.0	-3.0	3.5	-4.0
1.0	-1.0	1.0	-1.0	2.0	-1.5	1.0	-1.5	0.5	-1.0
2.0	-1.0	1.5	-1.5	2.0	-2.0	1.5	-1.0	0.5	-0.5
0.5	-1.0	2.0	-2.0	2.5	-1.0				

AVE. VARIATION = 0.0DB STANDARD DEVIATION = 4.2

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-5.25	0.0
-4.75	0.0
-4.25	0.0
-3.75	2.0
-3.25	1.0
-2.75	3.0
-2.25	5.0
-1.75	6.0
-1.25	8.0
-0.75	8.0
-0.25	5.0
0.25	0.0
0.75	7.0
1.25	5.0
1.75	5.0
2.25	10.0
2.75	5.0
3.25	3.0
3.75	1.0
4.25	1.0
4.75	1.0
5.25	0.0

NEGATIVE VALUES MEAN	=	-1.78
POSITIVE VALUES MEAN	=	1.83
NEGATIVE VARIANCE	=	0.91
POSITIVE VARIANCE	=	1.02
NEGATIVE STANDARD DEVIATION	=	0.96
POSITIVE STANDARD DEVIATION	=	1.01



X-SCALE=2.00E+00 UNITS INCH.

Y-SCALE=2.00E+00 UNITS INCH.

VARIATIONS RUN66 ROLL05 PITCH00

COURSE 090 E&M DIR. 144 DIST 4.17

VARIATIONS RUN66 ROLL05 PITCH00
COURSE 090 E&M DIR. 144 DIST 4.17

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

5.00	1.000
4.50	0.987
4.00	0.974
3.50	0.934
3.00	0.882
2.50	0.776
2.00	0.579
1.50	0.434
1.00	0.263
0.50	0.066

ANTENNA SIMULATION

LENGTH OF ANTENNA	=	.95 METERS
HEIGHT OF ANTENNA	=	18.2 METERS
PHI OF ANTENNA	=	000 DEGREES RELATIVE
THETA OF ANTENNA	=	000 DEGREES RELATIVE
FREQUENCY	=	149.0 MHZ
EPSILON	=	80.0
SIGMA	=	5.0
PHI OF PLØT	=	036 DEGREES RELATIVE
THETA OF PLØT	=	089 DEGREES RELATIVE
SEA STATE	=	2
DIRECTION OF SEA	=	018 DEGREES RELATIVE

ROLL (DEGREES)	PITCH (DEGREES)	SIGNAL STRENGTH (DB)
.9	.0	4.879
1.7	.0	1.461
2.5	.0	1.506
3.2	.0	2.832
3.8	.0	3.384
4.3	.0	2.889
4.6	.0	2.361
4.9	.0	2.104
4.9	.0	2.036
4.9	.0	2.104
4.6	.0	2.361
4.3	.0	2.889
3.8	.0	3.384
3.2	.0	2.832
2.5	.0	1.506
1.7	.0	1.461
.9	.0	4.879
-.9	.0	5.078
-1.7	.0	1.589
-2.5	.0	1.415
-3.2	.0	2.595
-3.8	.0	3.337
-4.3	.0	3.062
-4.6	.0	2.574
-4.9	.0	2.288
-4.9	.0	2.203
-4.9	.0	2.288
-4.6	.0	2.574
-4.3	.0	3.062
-3.8	.0	3.337
-3.2	.0	2.595
-2.5	.0	1.415
-1.7	.0	1.589
-.9	.0	5.078

AVERAGE VALUE = 2.67 DB

DISTRIBUTION RUN67 ROLLO5 PITCH00
COURSE 180 E&M DIR. 144 DIST 4.17

DATA POINTS

75.0	73.5	74.0	73.0	74.5	73.0	74.5	74.0	74.5
72.5	74.0	73.0	74.0	73.0	74.0	72.5	74.0	72.5
73.5	73.0	73.5	72.5	74.0	73.5	74.5	73.0	74.0
73.0	74.5	73.0	74.0	73.0	74.0	73.0	74.0	73.0
74.0	73.0	74.0	73.0	74.5	73.5	72.5	73.5	73.5
72.5	73.0	72.5	73.0	72.5	73.0	72.5	73.0	72.5
74.0	72.5	73.5	72.5	73.5	72.5	73.5	73.0	74.0
73.0	74.0	72.5	73.5	73.0	74.0	72.5		

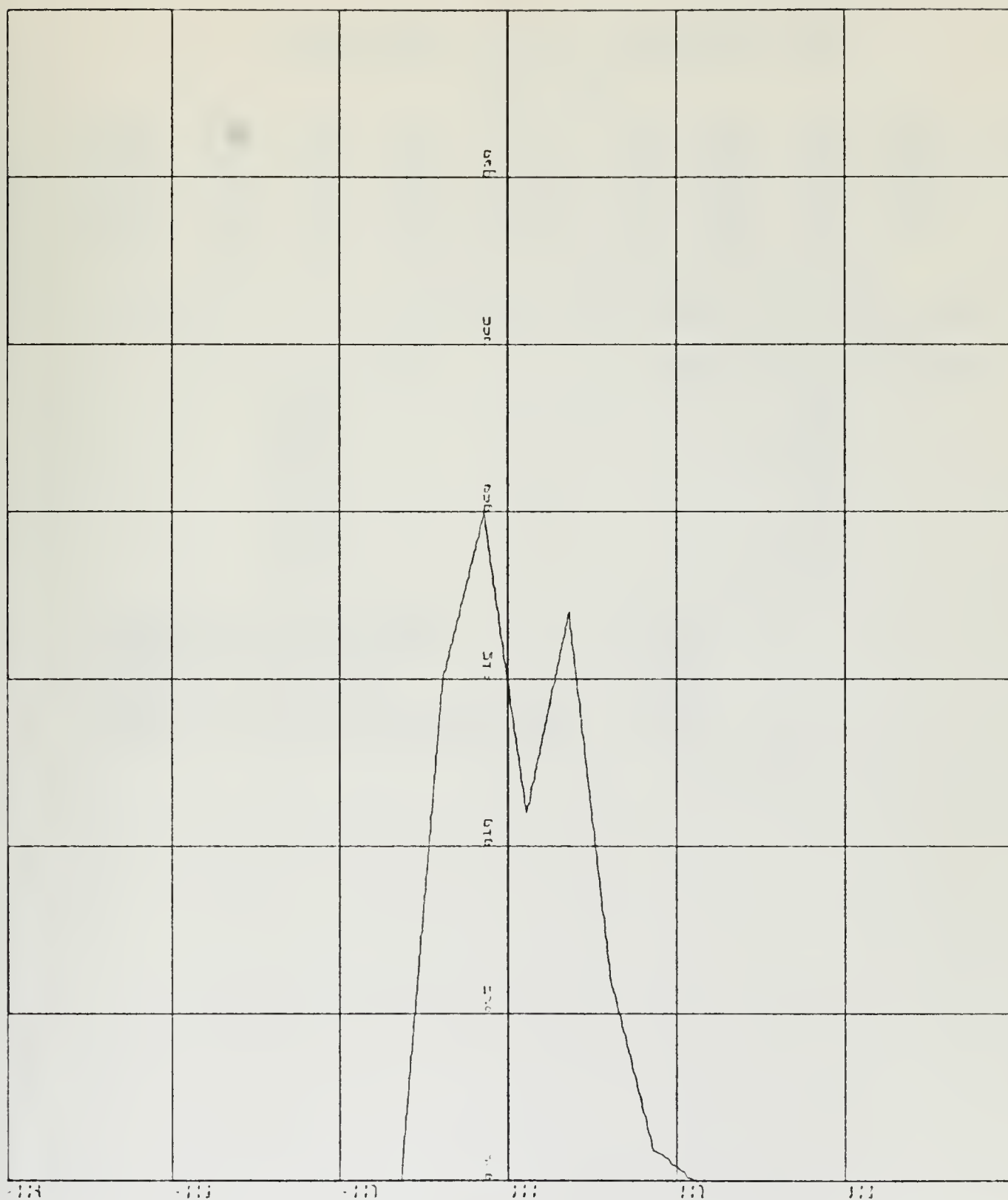
AVERAGE POWER = 73.4DB STANDARD DEVIATION = 0.5

GRAPHED DATA IS, NORMALIZED POWER VS. POINTS AT THAT POWER

NORMALIZED POWER, DB POINTS AT THAT POWER

-2.25	0.0
-1.75	0.0
-1.25	0.0
-0.75	15.0
-0.25	20.0
0.25	11.0
0.75	17.0
1.25	6.0
1.75	1.0
2.25	0.0

NEGATIVE VALUES MEAN	=	-0.59
POSITIVE VALUES MEAN	=	0.59
NEGATIVE VARIANCE	=	0.06
POSITIVE VARIANCE	=	0.15
NEGATIVE STANDARD DEVIATION	=	0.25
POSITIVE STANDARD DEVIATION	=	0.39



K-SCALE=2.00E+00 UNITS INCH.

V-SCALE=5.00E+00 UNITS INCH.

DISTRIBUTION RUN67 ROLLO5 PITCH00

COURSE 100 E&M DIR. 144 DIST 4.17

VARIATIONS RUN67 ROLL05 PITCH00
 COURSE 180 E&M DIR. 144 DIST 4.17

VARIATIONS									
-1.5	0.5	-1.0	1.5	-1.5	1.5	-0.5	0.5	-2.0	1.5
-1.0	1.0	-1.0	1.0	-1.5	1.5	-1.5	1.0	-0.5	0.5
-1.0	1.5	-0.5	1.0	-1.5	1.0	-1.0	1.5	-1.5	1.0
-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.0	-1.0	1.5
-1.0	-1.0	1.0	0.0	-1.0	0.5	-0.5	0.5	-0.5	0.5
-0.5	0.5	-0.5	1.5	-1.5	1.0	-1.0	1.0	-1.0	1.0
-0.5	1.0	-1.0	1.0	-1.5	1.0	-0.5	1.0		

AVE. VARIATION = -0.0DB STANDARD DEVIATION = 1.2

GRAPHED DATA IS, VARIATIONS VS. POINTS AT THAT VALUE

VARIATIONS, DB	POINTS AT THAT VALUE
-2.25	0.0
-1.75	1.0
-1.25	8.0
-0.75	16.0
-0.25	9.0
0.25	1.0
0.75	7.0
1.25	18.0
1.75	8.0
2.25	0.0

NEGATIVE VALUES MEAN = -1.01
 POSITIVE VALUES MEAN = 1.02
 NEGATIVE VARIANCE = 0.16
 POSITIVE VARIANCE = 0.12
 NEGATIVE STANDARD DEVIATION = 0.40
 POSITIVE STANDARD DEVIATION = 0.34



K-SCALE=2.00E+00 UNITS INCH.

V-SCALE=5.00E+00 UNITS INCH.

VARIATIONS RUN67 ROLL05 PITCH00
 COURSE 180 E&M DIR. 144 DIST 4.17

VARIATIONS RUN67 ROLLO5 PITCH00
COURSE 180 E&M DIR. 144 DIST 4.17

PEAK TO PEAK POWER
(ABSOLUTE VALUE, DB)

PROBABILITY VARIATION WILL
BE LESS THAN GIVEN AMMOUNT

2.00
1.50
1.00
0.50

1.000
0.868
0.485
0.147

APPENDIX B

[illegible]


```

        ASSIGN 2 TO IFO(24)
        ASSIGN 2 TO IFO(26)
        ASSIGN 2 TO IFO(28)
        ASSIGN 2 TO IFO(30)
        ASSIGN 2 TO IFO(32)
        ASSIGN 2 TO IFO(34)
        ASSIGN 2 TO IFO(36)
        ASSIGN 2 TO IFO(38)
        ASSIGN 2 TO IFO(40)
        ASSIGN 2 TO IFO(42)
        ASSIGN 2 TO IFO(44)
        DO 50 I=1,44
50  ENCODE(MC(I),IFO(I),IPAR(I))
170  CONTINUE
        DO 114 I=1,50
114  IM(I)=0
        DO 111 I=1,50
111  X1(I)=Y1(I)=0.0
        DO 112 I=1,90
112  X2(I)=Y2(I)=0.0
        DO 113 I=1,360
113  X3(I)=Y3(I)=0.0
33  CONTINUE
        DO 51 I=1,43,2
        CALL TEXT0(IDEV,IPAR(I),NW(I),LN(I),IP(I),1,3,IER)
51  IF(IER.NE.0)OUTPUT(101)IER,'TBLK',I
C  PARAMETER AND OPTIONS COMMAND INPUT PROCESSOR
        DO 52 I=2,44,2
        CALL TEXTR(IDEV,IPAR(I),NW(I),LN(I),IP(I),1,3,IER)
        IF(IER.NE.0)OUTPUT(101)IER,'TBLK',I
        J=22+I/2
53  IF(MOD(ITDIR(J),8).EQ.0) GO TO 53
        CALL TEXTI(IDEV,IPAR(I),NW(I),LN(I),IP(I),IER)
52  IF(IER.NE.0)OUTPUT(101)IER,'IPAR',I
1  FORMAT('ANTN')
3  FORMAT('LENG')
5  FORMAT('HGHT')
7  FORMAT('PHIP')
9  FORMAT('THEP')
11 FORMAT('FREQ')
13 FORMAT('EPSL')
15 FORMAT('SGMA')
17 FORMAT('PHI ')
19 FORMAT('THET')
21 FORMAT('PARM')
2  FORMAT(' ')
4  FORMAT(' ')
6  FORMAT(' ')
8  FORMAT(' ')
10 FORMAT(' ')
12 FORMAT(' ')
14 FORMAT(' ')
16 FORMAT(' ')
18 FORMAT(' ')
20 FORMAT(' ')
22 FORMAT(' ')
123 FORMAT('ISTH')
125 FORMAT('ISTV')
127 FORMAT('IRCL')
129 FORMAT('TUNA')
131 FORMAT('ALPH')
133 FORMAT('GAIN')
135 FORMAT('ISEA')
137 FORMAT('ICRS')
139 FORMAT('SIGL')
141 FORMAT(' ')
143 FORMAT(' ')
95 FORMAT(F4.0)
96 FORMAT(F4.1)
97 FORMAT(F4.2)
98 FORMAT(F4.3)
101 FORMAT(I4)

```



```

DECODE(4,101,IPAR(2))ANTN
DECODE(4,97,IPAR(4))L
DECODE(4,96,IPAR(6))H
DECODE(4,101,IPAR(8))ITEM
PHIPR=ITEM
DECODE(4,101,IPAR(10))ITEM
THEPR=ITEM
DECODE(4,95,IPAR(12))F
DECODE(4,96,IPAR(14))EPSLN
DECODE(4,97,IPAR(16))SIGMA
DECODE(4,101,IPAR(18))M
DECODE(4,101,IPAR(20))KAY
DECODE(4,101,IPAR(22))PAR
DECODE(4,101,IPAR(24))ISTRH
DECODE(4,101,IPAR(26))ISTRV
DECODE(4,101,IPAR(28))IRCAL
HT=0.00
DECODE(4,98,IPAR(30))TUNA
DECODE(4,101,IPAR(32))ITEM
ALPH=ITEM
DECODE(4,101,IPAR(36))ISEA
DECODE(4,101,IPAR(38))ICRS
IF(HT.EQ.(1.))SIGMA=SIGMA*.1
IF(HT.EQ.(2.))SIGMA=SIGMA*.01
IF(PAR.EQ.1)GO TO 170
IF(HT.GT.75.0)L=L+100.0
IF(HT.GT.85.0)L=L+200.0
CALL DGINIT(IDEV,IGDIR,ISIZE,IER)
DECODE(J,101,IPAR(8))IIP
DECODE(J,101,IPAR(10))IIT
9000 WRITE(6,9001)
9001 FORMAT(1H1,24X,'ANTENNA SIMULATION',/)
9100 WRITE(6,9101) L
9101 FORMAT(16X,'LENGTH OF ANTENNA',7X,'=',F6.2,' METERS')
WRITE(6,9111)H
9111 FORMAT(16X,'HIGHT OF ANTENNA',8X,'=',F6.1,' METERS')
IIP=IIP+1000
WRITE(6,9121)IIP
9121 FORMAT(16X,'PHI OF ANTENNA',10X,'=',3X,I3,
1 ' DEGREES RELATIVE')
IIT=IIT+1000
WRITE(6,9131)IIT
9131 FORMAT(16X,'THETA OF ANTENNA',8X,'=',3X,I3,
1 ' DEGREES RELATIVE')
WRITE(6,9141) F
9141 FORMAT(16X,'FREQUENCY',15X,'=',F6.1,' MHZ')
WRITE(6,9151)EPSLN
9151 FORMAT(16X,'EPSILON',17X,'=',F6.1)
WRITE(6,9161)SIGMA
9161 FORMAT(16X,'SIGMA',19X,'=',F6.1)
M=M+1000
WRITE(6,9171)M
9171 FORMAT(16X,'PHI OF PLOT',13X,'=',3X,I3,
1 ' DEGREES RELATIVE')
M=M-1000
KAY=KAY+1000
WRITE(6,9181)KAY
9181 FORMAT(16X,'THETA OF PLOT',11X,'=',3X,I3,
1 ' DEGREES RELATIVE')
KAY=KAY-1000
WRITE(6,9191)ISEA
9191 FORMAT(16X,'SEA STATE',15X,'=',I6)
ICRS=ICRS+1000
WRITE(6,9201)ICRS
9201 FORMAT(16X,'DIRECTION OF SEA',8X,'=',3X,I3,
1 ' DEGREES RELATIVE',/)
ICRS=ICRS-1000
WRITE(6,9211)
9211 FORMAT(18X,'ROLL',10X,'PITCH',6X,
1 ' SIGNAL STRENGTH')
WRITE(6,9213)
9213 FORMAT(16X,'(DEGREES)',5X,'(DEGREES)',9X,'(DB)',/)

```



```

C      IF(PAR.EQ.1)GO TO 170
      PATTERN MANUAL ENTRY PROCESSOR
      DO 151 I=1,50
151    IMD(I)=IM(I)
        ITRY(1)=IHEAD(0,10)
        ITRY(2)=IPACK(0,.6,0)
        ITRY(3)=IPACK(0,.4,1)
        ITRY(4)=IPACK(-.1,.5,0)
        ITRY(5)=IPACK(.1,.5,1)
        ITRY(6)=IPACK(0,-.6,0)
        ITRY(7)=IPACK(0,-.4,1)
        ITRY(8)=IPACK(-.1,-.5,0)
        ITRY(9)=IPACK(.1,-.5,1)
        ITRY(10)=IPACK(0,0,0)
      DO 153 I=11,50
      J=I-1
153    ITRY(I)=IPACK(X1(I),Y1(I),IMD(I))
        CALL GRAPHR(IDEV,ITRY,50,1,IER)
        IF(IER.NE.0)OUTPUT(101) IER,'GBLK1'
154    IF(MOD(IGDIR(1),8).EQ.0)GO TO 154
        CALL GRAPHI(IDEV,ITRY,1,IER)
        IF(IER.NE.0)OUTPUT(101)IER,'IGBLK'
      DO 155 I=1,50
        CALL UNPACK(ITRY(I),X1(I),Y1(I),IMD(I))
155    IM(I)=IMD(I)
C      ENVIRONMENTAL CONSTANTS PROCESSOR
      PHIPR=PHIPR*(3.14159265/180)
      THEPR=THEPR*(3.14159265/180)
      ALPH=(3.14159265/180)*ALPH
      ALPCM=(3.14159265/2.0)-ALPH
      DLPRI=(3.14159265/2.0)-THEPR
      F=F*1.0E 06
      AOMEG=2*3.14159265*F
      ADA1=CMPLX(0.0,1.26E-06*AOMEG)
      ADA2=CMPLX(SIGMA,AOMEG*EPSLN*8.854E-12)
      ADA=(ADA1/ADA2)**0.5
      TEMP1=REAL(ADA)
      TEMP2=AIMAG(ADA)
      LMDA=3.0E08/F
      K=6.28318530/LMDA
      F=F*1.0E-06
      C2=K*CMPLX(EPSLN,-1.8E04*SIGMA/F)**0.5
      RHPRI=(K-C2)/(K+C2)
      HTEMP=H
      THTEM=THEPR
      RVPRI=(C2-K)/(C2+K)
      JJJ=0
      AII=0.0
      AVE=0.0
      II=0
      DPHIP=0.0
      IF(ISEA.GT.0)GO TO 3000
3010 CONTINUE
C      INPUT RESISTANCE PROCESSOR
      IF(ANTN.EQ.1)GO TO 1100
      IF(ANTN.EQ.2)GO TO 1200
      IF(ANTN.EQ.3)GO TO 1300
      IF(ANTN.EQ.4)GO TO 1400
      IF(ANTN.EQ.5)GO TO 1500
      IF(ANTN.EQ.6)GO TO 1600
      IF(ANTN.EQ.7)GO TO 1700
      IF(ANTN.EQ.8)GO TO 1800
2000 CONTINUE
      IF(ISEA.GT.0)GO TO 3013
      WRITE(6,104)RIN
3013 CONTINUE
104  FORMAT(F12.4)
C      OBSERVATION ANGLE CONSTANTS PROCESSOR
      DO 42 N=1,2
      IF(N.EQ.1) GO TO 71
      IF(N.EQ.2) GO TO 72
      71 DO 42 I=1,90

```



```

      J=M
      E=I
      GO TO 73
72 DO 42 J=1,360
      I=KAY
      E=J
      GO TO 73
73 CONTINUE
      THETA=I*(3.14159265/180)
      PHI=J*(3.14159265/180)
      KOS=COS(THETA)*COS(THPR)+SIN(THETA)*SIN(THPR)*
1 COS(PHI-PHIPR)
      SINSQ=1-(KOS**2)
      WOSQ=(3.14159265/180)**2
      IF(SINSQ.LT.WOSQ)SINSQ=WOSQ
      FIF=(1-((K/C2)*SIN(THETA))**2)**0.5
      KCOS=COS(THETA)
      RV=(KCOS-(K/C2)*FIF)/(KCOS+(K/C2)*FIF)
      RH=(KCOS-(C2/K)*FIF)/(KCOS+(C2/K)*FIF)
      VR=REAL(RV)
      VI=AIMAG(RV)
      SIGHV=ATAN2(VI,VR)
      HR=REAL(RH)
      HI=AIMAG(RH)
      SIGHH=ATAN2(HI,HR)
C   GAIN PROCESSOR
      IF(ANTN.EQ.1)GO TO 100
      IF(ANTN.EQ.2)GO TO 200
      IF(ANTN.EQ.3)GO TO 300
      IF(ANTN.EQ.4)GO TO 400
      IF(ANTN.EQ.5)GO TO 500
      IF(ANTN.EQ.6)GO TO 600
      IF(ANTN.EQ.7)GO TO 700
      IF(ANTN.EQ.8)GO TO 800
C   42 CONTINUE
      NORMALIZE AND MAX GAIN PROCESSOR
      N=1
      DO 43 J=1,2
      IF(J.EQ.1) GO TO 75
      IF(J.EQ.2) GO TO 76
75 DO 43 I=1,90
      GO TO 77
76 DO 43 I=1,360
      GO TO 77
77 CONTINUE
      FAC(N)=G(J,I)
43 N=N+1
      NORM=0.0
      DO 46 I=1,450
46 NORM=AMAX1(NORM,FAC(I))
      GAIN=NORM/RIN
      IF(GAIN.GT.(.001)) GO TO 9700
      ATEMP=00.0
      GO TO 9772
9700 ATEMP=ALOG10(GAIN)
9772 ENCODE(4,96,IPAR(34))ATEMP
      CALL TEXT0(IDEV,IPAR(34),1,34,1,1,3,IER)
      IF(IER.NE.0)OUTPUT(101)IER,'GAIN'
      IF(ISEA.GT.0)GO TO 3020
      GAIN=10.*ATEMP
      IF(PAR.EQ.2)GO TO 171
181 CONTINUE
3021 CONTINUE
C   PATTERN DISPLAY PROCESSOR
      DO 44 I=1,360
      PHI=I*(3.14159265/180)
      G(2,I)=G(2,I)/(NORM*2.0)
      X(I)=G(2,I)*COS(PHI)
44 Y(I)=G(2,I)*SIN(PHI)+0.5
      IMD(1)=0
      DO 45 I=2,360
45 IMD(I)=1

```



```

PATRN(1)=IHEAD(0,10)
DO 47 I=2,361
  J=I-1
47 PATRN(I)=IPACK(X(J),Y(J),IMD(J))
  PATRN(362)=0
  IF(ISEA.GT.0)GO TO 3030
  CALL GRAPHR(IDEV,PATRN,362,2,IER)
  IF(IER.NE.0)OUTPUT(101)IER,'GBLK'
60 IF(MOD(IGDIR(2),8).EQ.0)GO TO 60
3011 CONTINUE
  IF(ISTRH.EQ.1) GO TO 156
  CONTINUE
C 158 DISPLAY VERT PATTERN AT REQUESTED PHI
  DO 49 I=1,90
    THETA=I*(3.14159265/180)
    G(1,I)=G(1,I)/(NORM*2.0)
    X(I)=G(1,I)*SIN(THETA)
49 Y(I)=G(1,I)*COS(THETA)-0.5
    IMD(1)=0
    DO 61 I=2,90
      61 IMD(I)=1
      VPAT(1)=IHEAD(0,10)
      DO 62 I=2,91
        J=I-1
62 VPAT(I)=IPACK(X(J),Y(J),IMD(J))
        VPAT(92)=0
        IF(ISEA.GT.0)GO TO 3040
        CALL GRAPHR(IDEV,VPAT,92,3,IER)
        IF(IER.NE.0) OUTPUT(101)IER,'GBLK2'
64 IF(MOD(IGDIR(3),8).EQ.0)GO TO 64
3012 CONTINUE
  IF(ISTRV.EQ.1)GO TO 159
  161 CONTINUE
  IF(IRCAL.EQ.1)GO TO 162
  IF(ISEA.GT.0)GO TO 3000
  GO TO 33
C PATTERN SAVE PROCESSOR
156 CALL GRAPHI(IDEV,PATRN,2,IER)
  IF(IER.NE.0)OUTPUT(101)IER,'GBLK2'
  DO 157 I=1,360
157 CALL UNPACK(PATRN(I+1),X3(I),Y3(I),IMD(I))
  GO TO 158
159 CALL GRAPHI(IDEV,VPAT,3,IER)
  IF(IER.NE.0)OUTPUT(101)IER,'GBLK3'
  DO 160 I=1,90
160 CALL UNPACK(VPAT(I+1),X2(I),Y2(I),IMD(I))
  GO TO 161
C DISPLAY SAVED PATTERNS PROCESSOR
162 IMD(1)=0
  ISAVH(1)=IHEAD(0,10)
  DO 163 I=2,360
163 IMD(I)=1
  DO 164 I=2,361
    J=I-1
164 ISAVH(I)=IPACK(X3(J),Y3(J),IMD(J))
    ISAVH(362)=0
    CALL GRAPHR(IDEV,ISAVH,362,4,IER)
    IF(IER.NE.0)OUTPUT(101)IER,'GBLK4'
166 IF(MOD(IGDIR(4),8).EQ.0)GO TO 166
    ISAVV(1)=IHEAD(0,10)
    DO 167 I=2,91
      J=I-1
167 ISAVV(I)=IPACK(X2(J),Y2(J),IMD(J))
      ISAVV(92)=0
      CALL GRAPHR(IDEV,ISAVV,92,5,IER)
      IF(IER.NE.0)OUTPUT(101)IER,'GBLK5'
169 IF(MOD(IGDIR(5),8).EQ.0)GO TO 169
  GO TO 33
C LOG GAIN PROCESSOR
171 BLIM=.001
  DO 172 I=1,90
    TEMP=G(1,I)/NORM

```



```

      IF(TEMP.LT.BLIM)TEMP=BLIM
      IF(TEMP.GT.(.001)) GO TO 9751
      G(1,1)=3.0
      GO TO 172
9751  G(1,1)=ALOG10(TEMP)+3.0
      172 CONTINUE
      DO 173 I=1,360
      TEMP=G(2,I)/NORM
      IF(TEMP.LT.BLIM)TEMP=BLIM
      IF(TEMP.GT.(.001)) GO TO 9752
      G(2,I)=3.0
      GO TO 173
9752  G(2,I)=ALOG10(TEMP)+3.0
      173 CONTINUE
      190 FORMAT(2F12.8,15)
      NORM=3.0
      GO TO 181
3000  II=II+1
      II=MOD(II,36)
      PI=3.14159265
      D2R=PI/180.0
      VAR=(PI/18.0)*II
      WAVE=(ISEA*8*SIN(VAR))*D2R
      VAR1=ICRS*D2R
      DLT1=WAVE*SIN(VAR1)
      DLT2=WAVE*COS(VAR1)*TUNA
      IF(ANTN.EQ.5)GO TO 3500
      H=HTEMP*COS(DLT1)*COS(DLT2)
      THEPR=THTEM-DLT1
      DLPR1=PI/2.-THEPR
      GO TO 3090
3500  AA=2*L*SIN(DLT1/2.)
      BB=2*L*SIN(DLT2/2.)
      CC=SQRT(AA**2+BB**2)
      DD=SQRT(L**2-(CC/2.）**2)
      DLT3=2.*ATAN2((CC/2.),DD)
      SIND3=SIN(DLT3)
      IF((SIND3.LT.WOSQ).AND.(SIND3.GE.0.0))SIND3=WOSQ
      IF((SIND3.GT.-WOSQ).AND.(SIND3.LT.0.0))SIND3=-WOSQ
      SINA=SIN(DLT1)/SIND3
      SINA=ABS(SINA)
      COSA=SQRT(1.0-SINA**2)
      DPHIP=ATAN2(SINA,COSA)
      IF((DLT1.LT.0.0).AND.(DLT2.GE.0.0))DPHIP=-DPHIP
      IF((DLT1.LT.0.0).AND.(DLT2.LT.0.0))DPHIP=-(PI-DPHIP)
      IF((DLT1.GT.0.0).AND.(DLT2.LT.0.0))DPHIP=PI-DPHIP
      THEPR=THTEM+DLT3
      DLPR1=PI/2.-THEPR
3090  JJJ=JJJ+1
      IF(JJJ.LT.37) GO TO 3010
      WRITE(6,9555)AVE
9555  FORMAT(/,16X,'AVERAGE VALUE =',F6.2,' DB')
      GO TO 33
3020  TEMP=G(1,KAY)/RIN
      IF(TEMP.GT.(0.001)) GO TO 9951
      SIGL=0.0
      GO TO 9952
9951  SIGL=ALOG10(TEMP)
9952  ENCODE(4,96,IPAR(40))SIGL
      CALL TEXT0(IDEV,IPAR(40),1,40,1,1,3,IER)
      IF(IER.NE.0)OUTPUT(101)IER,'SIGL'
      SIG=10*SIGL
      DLT1A=DLT1*(180./3.14159265)
      DLT2A=DLT2*(180./3.14159265)
      IF(DLT1A.GT.(-.099)) GO TO 9314
      GO TO 9617
9314  IF(DLT1A.LT.(.099)) GO TO 9217
      GO TO 9617
9217  IF(DLT2A.GT.(-.099)) GO TO 9227
      GO TO 9617
9227  IF(DLT2A.LT.(.099)) GO TO 9207
9617  WRITE(6,9200)DLT1A,DLT2A,SIG

```



```

9200 FORMAT(16X,F6.1,10X,F5.1,10X,F6.3)
    AII=AII+1
    AVE=AVE-(AVE-SIG)/AII
9207 WSIG=SIG/30.
    CALL DAC(2,WSIG)
    GO TO 3021
3030 CALL GRAPHO(IDEV,PATRN,362,2,IER)
    IF(IER.NE.0)OUTPUT(101)IER,'HPAT'
    GO TO 3011
3040 CALL GRAPHO(IDEV,VPAT,92,3,IER)
    IF(IER.NE.0)OUTPUT(101)IER,'VPAT'
    GO TO 3012
C
100  ARBITRARILY TILTED DIPOLE
    DELTA=(3.14159265/2.-THETA)
    S1=COS(SIGHH-2*K*H*SIN(DELTA))
    S2=SIN(SIGHH-2*K*H*SIN(DELTA))
    S3=COS(SIGHV-2*K*H*SIN(DELTA))
    S4=SIN(SIGHV-2*K*H*SIN(DELTA))
    CV=CABS(RV)
    CH=CABS(RH)
    COSDL=COS(DELTA)
    SINDL=SIN(DELTA)
    SINDP=SIN(DLPRI)
    COSDP=COS(DLPRI)
    SINPI=SIN(PHI-PHIPR)
    COSPI=COS(PHI-PHIPR)
    FCT=1.0-(SINDL*SINDP+COSDL*COSDP*SINPI)**2
    FCTR=1.0-(-SINDP*SINDL+COSDL*COSDP*SINPI)**2
    GI=(COS(0.5*K*L*(SINDL*SINDP+COSDL*COSDP*SINPI))
1-COS(0.5*K*L))/FCT
    DI=(COS(0.5*K*L*(COSDL*COSDP*SINPI-SINDL*SINDP))
1-COS(0.5*K*L))/FCTR
    ETHT1=(COSDP*SINPI*SINDL-SINDP*COSDL)*GI-(COSDP*SINPI*
1SINDL+SINDP*COSDL)*DI*CV*S3
    EPHI1=COSDP*COSPI*(GI+DI*CH*S1)
    ETHT2=(COSDP*SINPI*SINDL+SINDP*COSDL)*DI*CV*S4
    EPHI2=COSDP*COSPI*DI*CH*S2
    IF(FCT.LT.WOSQ)ETHT1=EPHI1=0.0
    IF(FCTR.LT.WOSQ)ETHT2=EPHI2=0.0
    G(N,E)=120.*(ETHT1**2+ETHT2**2+EPHI1**2+EPHI2**2)
    GO TO 42
1100 SAVIT=DLPRI
    DO 1110 I=1,2
    YO=.00001
    ZO=0.0
    IF(I.EQ.1)DLPRI=0.0
    IF(I.EQ.2)DLPRI=SAVIT
    IF(I.EQ.2)YO=2.*H*COS(DLPRI)/LMDA
    S=-0.5*L/LMDA
    RGRAL=RESIST(S)/2
    DS=L/(LMDA*100)
    DO 1115 N=2,100
    S=S+DS
1115 RGRAL=RESIST(S)+RGRAL
    RGRAL=-30.0*(RGRAL+(RESIST(0.5*L/LMDA))/2.)*DS
    S=-0.5*L/LMDA
    XGRAL=REACT(S)/2.
    DO 1116 N=2,100
    S=S+DS
1116 XGRAL=XGRAL+REACT(S)
    XGRAL=-30.0*(XGRAL+(REACT(0.5*L/LMDA))/2)*DS
1110 Z(I)=CMPLX(RGRAL,XGRAL)
    AJ=CMPLX(0,1)
    ONE=COS(DLPRI)
    TWO=-SIN(DLPRI)
    CEE=(RHPRI*COS(DLPRI)+AJ*RVPRI*SIN(DLPRI))*
1CMPLX(ONE,TWO)
    RIN=REAL(Z(1))+REAL(Z(2)*CEE)
    GO TO 2000
1500 CALL SINUS((2*K*L),SC)
    SI1=-SC
    CALL KOSINUS((2*K*L),CC)

```



```

      CI1=CC
      CALL KOSINUS((4*K*L),CC)
      CI2=CC
      CALL SINUS((4*K*L),SC)
      SI2=-SC
      TUN2=K*L
      IF(TUN2.GT.(.001)) GO TO 9955
      RIN=30.0*(0.5*(0.577-CI2)+.693+COS(K*L)*(COS(K*L)*
1 (.577-2*CI1+CI2)-SIN(K*L)*(SI2-2.*SI1)))
      GO TO 9956
9955 RIN=30.0*(0.5*(ALOG(K*L)+0.577-CI2)+.693+COS(K*L)*
1 (COS(K*L)*
1 (ALOG(K*L)+.577-2*CI1+CI2)-SIN(K*L)*(SI2-2.*SI1)))
9956 GO TO 2000
C 800 VERTICAL HALF RHOMBIC
      DELTA=(3.14159265/2.0)-THETA
      COSDL=COS(DELTA)
      SINDL=SIN(DELTA)
      COSAC=COS(ALPCM)
      SINAC=SIN(ALPCM)
      COSPI=COS(PHI)
      SINPI=SIN(PHI)
      FACK1=1.0-COSDL*COSAC*COSPI-SINDL*SINAC
      FACK2=1.0-COSDL*COSAC*COSPI+SINDL*SINAC
      UU1=COS(SIGHH-2*K*H*SINDL)
      UU2=SIN(SIGHH-2*K*H*SINDL)
      UU3=COS(SIGHV-2*K*H*SINDL)
      UU4=SIN(SIGHV-2*K*H*SINDL)
      S1=SIN(K*L*FACK1)
      CE1=COS(K*L*FACK1)
      S2=SIN(K*L*FACK2)
      CE2=COS(K*L*FACK2)
      R1=(1.0-CE1)/FACK1
      AI1=S1/FACK1
      R2=(CE1*(1.0-CE2)+S1*S2)/FACK2
      AI2=(CE1*S2-S1*(1.0-CE2))/FACK2
      R3=(1.0-CE1)*COS(2*K*L*SINAC*SINDL)-(1.0-CE1)*SIN(2*K*
1 L*SINAC*SINDL)
      F1=(AI3*CE1-R3*S1)/FACK1
      F2=(R3*CE1+AI3*S1)/FACK1
      F3=(1.0-CE2)/FACK2
      F4=S2/FACK2
      RB=R1+R2+CABS(RV)*((F2+F3)*UU3-(F1+F4)*UU4)
      BI=AI1+AI2-CABS(RV)*((F2+F3)*UU4+(F1+F4)*UU3)
      RC=R2-R1+CABS(RV)*((F2-F3)*UU3-(F1-F4)*UU4)
      CC=AI2-AI1+CABS(RV)*((F2-F3)*UU4+(F1-F4)*UU3)
      RA=R1+R2+CABS(RH)*((F2+F3)*UU1+(F1+F4)*UU2)
      A1=AI1+AI2+CABS(RH)*((F2+F3)*UU2+(F1+F4)*UU1)
      G(N,E)=0.1*((RB*COSAC*COSPI*SINDL+RC*SINAC*COSDL)**2
1 +(BI*COSAC*COSPI*SINDL+CC*SINAC*COSDL)**2+(RA*COSAC*
1 SINPI)**2+(A1*COSAC*SINPI)**2)
      GO TO 42
C 1800 VERTICAL HALF RHOMBIC
      RIN=1.0
      GO TO 2000
C 600 SLOPING VEE
      DELTA=(3.14159265/2.0)-THETA
      SINDL=SIN(DELTA)
      SINDP=SIN(DLPRI)
      COSDL=COS(DELTA)
      COSDP=COS(DLPRI)
      ADJ=COS(ALPH)*COSDP
      OPP=SIN(ALPH)
      ALPH=ATAN2(OPP,ADJ)
      COSP=COS(PHI+ALPH)
      COSM=COS(PHI-ALPH)
      KOS1=SINDL*SINDP+COSDL*COSDP*COSM
      KOS2=SINDL*SINDP+COSDL*COSDP*COSP
      KOS3=-SINDL*SINDP+COSDL*COSDP*COSM
      KOS4=-SINDL*SINDP+COSDL*COSDP*COSP
      KOS5=COSDL*SINDP+SINDL*COSDP*COSM
      KOS6=COSDL*SINDP+SINDL*COSDP*COSP

```



```

KOS7=-COSDL*SINDP+SINDL*COSDP*COSM
KOS8=-COSDL*SINDP+SINDL*COSDP*COSP
U1=K*L*(1.0-KJ S1)
U2=K*L*(1.0-KJ S2)
U3=K*L*(1.0-KJ S3)
U4=K*L*(1.0-KJ S4)
S1=COS(SIGHH-2*K*H*SINDL)
S2=SIN(SIGHH-2*K*H*SINDL)
S3=COS(SIGHV-2*K*H*SINDL)
S4=SIN(SIGHV-2*K*H*SINDL)
COSU1=COS(U1)
COSU2=COS(U2)
COSU3=COS(U3)
COSU4=COS(U4)
SINU1=SIN(U1)
SINU2=SIN(U2)
SINU3=SIN(U3)
SINU4=SIN(U4)
A=(KOS7*(COSU1-1.)/U1-KOS8*(COSU2-1.)/U2)+CABS(RV)*(
1(KOS6*(
1(COSU4-1.)*S3+SINU4*S4)/U4)-KOS5*((COSU3-1.)*S3+SINU3*
1S4)/U3)
B=(KOS8*SINU2/U2-KOS7*SINU1/U1)+CABS(RV)*(KOS5*(SINU3*
1S3-(COSU3-1.
1)*S4)/U3+KOS6*((COSU4-1.)*S4-SINU4*S3)/U4)
C=SIN(PHI+ALPH)*(COSU2-1.)/U2-SIN(PHI-ALPH)*(COSU1-1.
1/U1
1+CABS(RH)*((SIN(PHI+ALPH)*(COSU4-1.)/U4-SIN(PHI-ALPH)*
1(COSU3-1.
1/U3)*S1-(SIN(PHI-ALPH)*SINU3/U3-SIN(PHI+ALPH)*SINU4/U4
1)*S2)
D=SIN(PHI-ALPH)*SINU1/U1-SIN(PHI+ALPH)*SINU2/U2+CABS(
1RH)*((SIN(PHI
1-ALPH)*SINU3/U3-SIN(PHI+ALPH)*SINU4/U4)*S1+(SIN(PHI+
1ALPH)*
1(COSU4-1.)/U4-SIN(PHI-ALPH)*(COSU3-1.)/U3)*S2)
G(N,E)=0.05*(A**2+B**2+COSDP**2*(C**2+D**2))
GO TO 42
C
C
200 VERTICAL MONOPOLE
VERTICAL MONOPOLE GAIN
DELTA=3.14159264/2.-THETA
SINDL=SIN(DELTA)
COSDL=COS(DELTA)
CV=CABS(RV)
S3=COS(SIGHV)
S4=SIN(SIGHV)
A=COS(K*L*SINDL)-COS(K*L)
B=SIN(K*L*SINDL)-SINDL*SIN(K*L)
G(N,E)=(30.0/COSDL**2)*((A*(1.+CV*S3)+B*CV*S4)**2+
1(B*(1.-CV*S3)+A*CV*S4)**2)
GO TO 42
C
C
1200 VERTICAL MONOPOLE
CALL KOSINUS((4*K*L),CC)
CIN2=ALOG(4*K*L)+.577-CC
CALL KOSINUS((2*K*L),CC)
CIN1=ALOG(2*K*L)+.577-CC
CALL SINUS((4*K*L),SC)
SIN2=1.57078633+SC
CALL SINUS((2*K*L),SC)
SIN1=1.57078633+SC
RIN=15.*((2.+2*COS(2*K*L))*CIN1-COS(2*K*L)*CIN2-2*SIN(
12*K*L)*SIN1+
1SIN(2*K*L)*SIN2)
GO TO 2000
C
C
400 INVERTED L
DELTA=(3.14159265/2.)-THETA
SINDL=SIN(DELTA)
COSDL=COS(DELTA)
CV=CABS(RV)
CH=CABS(RH)
DENM1=1.0-COSDL**2*SIN(PHI)**2
S1=COS(SIGHH-2*K*H*SINDL)

```



```

S2=SIN(SIGHH-2*K*H*SINDL)
S3=COS(SIGHV-2*K*H*SINDL)
S4=SIN(SIGHV-2*K*H*SINDL)
A=COS(K*L)*COS(K*H*SINDL)-SINDL*SIN(K*L)*SIN(K*H*
1SINDL)
1-COS(K*(H+L))
B=SINDL*SIN(K*L)*COS(K*H*SINDL)+COS(K*L)*SIN(K*H*
1SINDL)
1-SINDL*SIN(K*(H+L))
GI=SIN(K*L*COSDL*SIN(PHI))-COSDL*COS(PHI)*SIN(K*L)
GR=COS(K*L*COSDL*SIN(PHI))-COS(K*L)
ETHET=((SIN(PHI)*SINDL*(GR*(1.0-CV*S3)+GI*CV*S4)/
1DENM1)
1-(A*(1.0+CV*COS(SIGHV))+B*CV*SIN(SIGHV))/COSDL)**2
1+((SIN(PHI)*SINDL*(GI*(1.0-CV*S3)-GR*CV*S4)/DENM1)
1-(B*(1.0-CV*COS(SIGHV))+A*CV*SIN(SIGHV))/COSDL)**2
EPhi=(COS(PHI)/DENM1)**2*((GR*(1.0+CH*S1)-GI*CH*S2)**2
1+(GI*(1.0+CH*S1)+GR*CH*S2)**2)
G(N,E)=30.0*(ETHET+EPhi)
GO TO 42
C
1400 INVERTED L
CALL KOSINUS((2*K*H),CC)
CI1=CC
CALL KOSINUS((4*K*H),CC)
CI2=CC
CALL SINUS((2*K*H),SC)
SI1=-SC
CALL SINUS((4*K*H),SC)
SI2=-SC
RIN=60.*(1.41+ALOG(2*L/LMDA)+SINC(2*K*L))+30.*(-0.5*
1COS(2*K*H)*
1(ALOG(2*K*H)+1.270+CI2)+(1.0+COS(2*K*H))*(ALOG(2*K*H)+
10.577-CI1)-
1SIN(2*K*H)*(0.5*SI2-SI1))
GO TO 2000
C
300 VERTICAL MONOPOLE WITH GROUND SCREEN
DELTA=3.14159265/2.-THETA
IF((N.EQ.2).AND.(J.GT.1))GO TO 310
SINDL=SIN(DELTA)
COSDL=COS(DELTA)
CV=CABS(RV)
S3=COS(SIGHV)
S4=SIN(SIGHV)
A=COS(K*L*SINDL)-COS(K*L)
B=SIN(K*L*SINDL)-SINDL*SIN(K*L)
C1=SIN(K*L)
IF((C1.LT.WOSQ).AND.(C1.GE.0.0))C1=WOSQ
IF((C1.GT.-WOSQ).AND.(C1.LT.0.0))C1=-WOSQ
C3=A
IF((C3.LT.WOSQ).AND.(C3.GE.0.0))C3=WOSQ
IF((C3.GT.-WOSQ).AND.(C3.LT.0.0))C3=-WOSQ
XB=K*H
DX=XB/100
XX=0
GRAL=PTGRL(XX)/2
DO 315 II=2,100
XX=XX+DX
315 GRAL=GRAL+PTGRL(XX)
GRAL=(GRAL+PTGRL(XB)/2)*DX
GRAL=1.0-(ADA*SIN(THETA)*GRAL)/120.*3.14159265*C1*C3
SRFAC=(CABS(GRAL))**2
WRITE(6,311)SRFAC
311 FORMAT('SRFAC=',F12.6)
310 CONTINUE
G(N,E)=(30.0/COSDL**2)*((A*(1.+CV*S3)+B*CV*S4)**2+
1(B*(1.-CV*S3)+A*CV*S4)**2)*SRFAC/C1**2
GO TO 42
C
1300 GROUND SCREEN
C1=SIN(K*L)**2
IF(C1.LT.WOSQ)C1=WOSQ
RO=(H**2+L**2)**0.5
R1=H+RO

```



```

      ARGP=CMPLX(0.0,K*L)
      ARGM=CMPLX(0.0,-K*L)
      ARGP2=CMPLX(0.0,2*K*L)
      ARGM2=CMPLX(0.0,-2*K*L)
      DLTZ1=(ADA/4*3.14159265*CI)*(CEXP(ARGP2)*AKEX(-2*K
1*(RO+L)))+
1CEXP(ARGM2)*AKEX(-2*K*(RO-L))+2*COS(K*L)**2*AKEX(-2*K*
1H))+
14*COS(K*L)*AKEX(-K*R1)-4*COS(K*L)*CEXP(ARGM)*AKEX(-K*(
1R1-L))-
14*CCS(K*L)*CEXP(ARGP)*AKEX(-K*(R1+L)))
      WRITE(6,1311)DLTZ1
1311  FORMAT('DLTZ1=',F12.6)
      NN=120
      WIRE=.01
      DX=(H-.01)/100
      DUM=.01
      DLTZ2=ZGRAL(DJM)/2.
      DO 1310 II=2,120
      DUM=DUM+DX
1310  DLTZ2=DLTZ2+ZGRAL(DUM)
      DLTZ2=(DLTZ2+ZGRAL(H)/2.)*DX
      DLTZ2=-DLTZ2
1312  WRITE(6,1312)DLTZ2
      FORMAT('DLTZ2=',F12.6)
      CALL KOSINUS((4*K*L),CC)
      CIN2=ALOG(4*K*L)+.577-CC
      CALL KOSINUS((2*K*L),CC)
      CIN1=ALOG(2*K*L)+.577-CC
      CALL SINUS((4*K*L),SC)
      SIN2=1.57078633+SC
      CALL SINUS((2*K*L),SC)
      SIN1=1.57078633+SC
      RIN=15.*((2.+2*COS(2*K*L))*CIN1-COS(2*K*L)*CIN2-2*SIN(
1*K*L)*SIN1
1+SIN(2*K*L)*SIN2)
      RIN=RIN+REAL(DLTZ1+DLTZ2)
      GO TO 2000
C      SLOPING LONG WIRE
C      SLOPE LONGWIRE
500  DELTA=3.14159265/2.0-THETA
      PHI=PHI-DPHIP
      COSDL=COS(DELTA)
      SINDL=SIN(DELTA)
      COSDP=COS(DLPRI)
      SINDP=SIN(DLPRI)
      COSPI=COS(PHI)
      SINPI=SIN(PHI)
      FCT1=1.0-(SINDL*SINDP+COSDL*COSDP*COSPI)**2
      FCT2=1.0-(COSDL*COSDP*COSPI-SINDL*SINDP)**2
      CIG=(COS(K*L*(SINDL*SINDP+COSDL*COSDP*COSPI))-COS(K*L)
1/FCT1
      SIG=(SIN(K*L*(SINDL*SINDP+COSDL*COSDP*COSPI))-
1(SINDL*SINDP+COSDL*COSDP*COSPI)*SIN(K*L))/FCT1
      CIGP=(COS(K*L*(COSDL*COSDP*COSPI-SINDL*SINDP))-COS(K*
1L))/FCT2
      SIGP=(SIN(K*L*(COSDL*COSDP*COSPI-SINDL*SINDP))+
1(SINDL*SINDP-COSDL*COSDP*COSPI)*SIN(K*L))/FCT2
      CH=CABS(RH)
      CV=CABS(RV)
      EPHI1=-COSDP*SINPI*(CIG+CH*(CIGP*COS(SIGHH)-SIGP*SIN(
1SIGHH)))
      EPHI2=-COSDP*SINPI*(SIG+CH*(CIGP*SIN(SIGHH)+SIGP*COS(
1SIGHH)))
      ETHT1=CIG*(COSDP*COSPI*SINDL-SINDP*COSDL)-CV*(COSDP*
1COSPI*SINDL+
1SINDP*COSDL)*(CIGP*COS(SIGHV)-SIGP*SIN(SIGHV))
      ETHT2=SIG*(COSDP*COSPI*SINDL-SINDP*COSDL)-CV*(COSDP*
1COSPI*SINDL+
1SINDP*COSDL)*(CIGP*SIN(SIGHV)+SIGP*COS(SIGHV))
      IF(FCT1.LT.WOSQ)ETHT1=ETHT2=EPHI1=EPHI2=0.0
      G(N,E)=30.0*(EPHI1**2+EPHI2**2+ETHT1**2+ETHT2**2)

```



```

IF((FCT1.LT.WOSG).AND.(FCT2.LT.WOSQ))G(N,E)=0.1
GO TO 42
END

```

```

SUBROUTINE SINUS(X,SC)
IF(X.GE.10.0)GO TO 10
DX=X/100
GRAL=0.5
XA=0.0
DO 100 I=2,100
XA=XA+DX
100 GRAL=GRAL+SINC(XA)
GRAL=(GRAL+SINC(X)/2.)*DX
SC=-3.14159265/2.+GRAL
GO TO 20
10 SC=-COS(X)/X
20 CONTINUE
RETURN
END

```

```

SUBROUTINE KOSINUS(X,CC)
IF(X.GE.10.0)GO TO 10
DX=X/100
GRAL=0.0
XA=0.0
DO 100 I=2,100
XA=XA+DX
100 GRAL=GRAL+(1.0-COS(XA))/XA
GRAL=(GRAL+(1.0-COS(X))/2*X)*DX
CC=ALOG(1.781072*X)-GRAL
GO TO 20
10 CC=SIN(X)/X
20 CONTINUE
RETURN
END

```

```

FUNCTION CINC(X)
CINC=COS(X)/X
RETURN
END

```

```

FUNCTION SINC(X)
SINC=SIN(X)/X
RETURN
END

```

```

C REQUIRED FOR DIPOLE
FUNCTION RESIST(S)
REAL L,LMDA,K
COMPLEX ADA
COMMON /IMP/ ZO,YO,L,DLPRI,LMDA,NN,WIRE,K,ADA,COSDL
PI=3.14159265
SZ=S*COS(2*DLPRI)
SY=-S*SIN(2*DLPRI)
TERM=Y0+SY
ROW2=(Y0+SY)**2
CA=ZO+SZ
CA1=CA+0.5*L/LMDA
CA2=CA-0.5*L/LMDA
R=SQRT(ROW2+CA**2)
R1=SQRT(ROW2+CA1**2)
R2=SQRT(ROW2+CA2**2)
SR=SIN(2*PI*R)/R
SR1=SIN(2*PI*R1)/R1
SR2=SIN(2*PI*R2)/R2
FACR=2*SR*COS(PI*L/LMDA)
RESIST=((SR1*CA1+SR2*CA2-FACR*CA)*SY)/TERM+(FACR-SR1-

```


1SR2)*SZ)*SIN(2*PI*(0.5*L/LMDA-ABS(S)))/S

```

FUNCTION REACT(S)
C REQUIRED FOR DIPOLE
COMPLEX ADA
REAL L,LMDA,K
COMMON /IMP/ Z0,Y0,L,DLPRI,LMDA,NN,WIRE,K,ADA,COSDL
PI=3.14159265
SZ=S*COS(2*DLPRI)
SY=-S*SIN(2*DLPRI)
TERM=Y0+SY
ROW2=(Y0+SY)**2
CA=Z0+SZ
CA1=CA+0.5*L/LMDA
CA2=CA-0.5*L/LMDA
R=SQRT(ROW2+CA**2)
R1=SQRT(ROW2+CA1**2)
R2=SQRT(ROW2+CA2**2)
CR=COS(2*PI*R)/R
CR1=COS(2*PI*R1)/R1
CR2=COS(2*PI*R2)/R2
FACX=2*CR*COS(PI*L/LMDA)
REACT=((CR1*CA1+CA2*CR2-FACX*CA)*SY)/ROW2+(FACX-CR1-
1CR2)*SZ)*SIN(2*PI*(0.5*L/LMDA-ABS(S)))/S
RETURN
END
LOAD XR,MAP
DATA

```



```

C      THIS PROGRAM ANALIZES SIGNAL STRENGTH PEAKS
C
C      SIGNAL PEAKS ARE INPUT AND PEAK TO PEAK VARIATIONS
C      ARE COMPUTED. NEXT THE DISTRIBUTION OF THE
C      PEAK TO PEAK VARIATIONS IS COMPUTED AND PLOTTED.
C      FINALLY THE PROBABILITY THAT THE VARIATIONS WILL
C      BE LESS THAN A CERTAIN VALUE IS COMPUTED.
      DIMENSION X(900),Y(900),Z(900),ZN(900),ZP(900),TOP(900)
      REAL LABEL/ ' ' /
      REAL*8 TITLE(12)
5      READ(5,6)NOPLOT
6      FORMAT(I3)
      READ(5,7)DELTA
7      FORMAT(F10.4)
      READ(5,8)(TITLE(I),I=1,2)
8      FORMAT(2A8)
      DO 1000 J=1,NOPLOT
C      INITIALIZE PARAMETERS FOR CALCOMP PLOT
      IWIDE=6
      IHIGH=7
      IGRID=1
      ITYPE=0
      MC=0
      IXUP=0
      IYRT=3
      MDXAX=2
      MDYAX=2
      EXSC=0
      YSCL=0
9      WRITE(6,9)
      FORMAT(1H1,////)
      READ(5,10)(TITLE(I),I=3,6)
10     FORMAT(4A8)
      READ(5,11)(TITLE(I),I=7,12)
11     FORMAT(6A8)
      WRITE(6,12)(TITLE(I),I=1,6)
      WRITE(6,12)(TITLE(I),I=7,12)
12     FORMAT(27X,6A8)
      WRITE(6,13)
13     FORMAT(/,36X,' VARIATIONS ')
15     AVE=0.0
      READ(5,6)NPTSS
      AI=0.0
      READ(5,20){Z(I),I=1,NPTSS)
20     FORMAT(F8.3)
      NPT=NPTSS-2
C      COMPUTE PEAK TO PEAK VARIATIONS
C      COMPUTE AVERAGE AND STANDARD DEVIATION
      DO 100 I=1,NPT
      AI=AI+1.0
      II=I+1
      Z1=Z(I)
      Z2=Z(II)
      Z(I)=Z2-Z1
      AVE=AVE-(AVE-Z(I))/AI
      AA=AI
100    CONTINUE
104    WRITE(6,105)(Z(I),I=1,NPT)
105    FORMAT(13X,10F6.1)
106    ST1=0.0
      DO 108 I=1,NPT
      ST1=ST1+(AVE-Z(I))*(AVE-Z(I))/(AI-1.0)
108    CONTINUE
C      FIND MAXIMUM VALUE
      IN=0
      IP=0
      ZM=0.0
      DO 130 I=1,NPT
      IF(Z(I)) 110,130,120

```



```

110  IN=IN+1
      ZN(IN)=Z(I)
      IF(ZN(IN)+ZM)125,130,130
120  IP=IP+1
      ZP(IP)=Z(I)
      IF(ZP(IP)-ZM)130,130,125
125  ZM=SQRT(Z(I)*Z(I))
130  CONTINUE
      ZZ=0.0
131  IF(ZM-ZZ) 134,134,132
132  ZZ=ZZ+1.0
      GO TO 131
134  ZM=ZZ+DELTA
C    COUNT NUMBER OF POINTS IN EACH TWO DELTA INTERVAL
      AI=0.0
      I=0
140  I=I+1
      X(I)=AI-ZM
      XL=X(I)-DELTA
      XM=X(I)+DELTA
      Y(I)=0.0
      DO 150 K=1,NPT
      IF(XL.GT.Z(K).OR.Z(K).GE.XM) GO TO 150
      Y(I)=Y(I)+1.0
150  CONTINUE
      AI=AI+DELTA*2.0
      IF(ZM-X(I))160,160,140
160  NPTS=I
      WRITE(6,180)AVE,ST1
180  FORMAT(/,16X,'AVE. VARIATION =',F5.1,'DB',5X,
1  'STANDARD DEVIATION = ',F5.1,/)
      IF(NPT.LT.210) GO TO 185
      WRITE(6,9)
      WRITE(6,12)(TITLE(I),I=1,6)
      WRITE(6,12)(TITLE(I),I=7,12)
185  WRITE(6,190)
190  FORMAT(16X,'GRAPHED DATA IS, VARIATIONS ',
1  'VS. POINTS AT THAT VALUE',/)
      WRITE(6,195)
195  FORMAT(16X,' VARIATIONS, DB',13X,
1  'POINTS AT THAT VALUE')
C    PRINT DISTRIBUTION
      DO 230 I=1,NPTS
      WRITE(6,200) X(I),Y(I)
200  FORMAT(20X,F10.2,20X,F10.1)
230  CONTINUE
C    COMPUTE AVERAGE, VARIANCE, AND STANDARD DEVIATION FOR
C    BOTH POSITIVE AND NEGATIVE DISTRIBUTIONS
      AP=0.0
      AN=0.0
      APOS=0.0
      ANEG=0.0
      DO 240 I=1,IN
      AN=AN+1.0
      ANEG=ANEG-(ANEG-ZN(I))/AN
240  CONTINUE
      DO 260 I=1,IP
      AP=AP+1.0
      APOS=APOS-(APOS-ZP(I))/AP
260  CONTINUE
      WRITE(6,270)ANEG
270  FORMAT(/,16X,'NEGATIVE VALUES MEAN',8X,'=',F7.2)
      WRITE(6,275)APOS
275  FORMAT(16X,'POSITIVE VALUES MEAN',8X,'=',F7.2)
      STNEG=0.0
      STPOS=0.0
      DO 325 I=1,IN
      STNEG=STNEG+(ANEG-ZN(I))*(ANEG-ZN(I))/(AN-1.0)
325  CONTINUE
      DO 330 I=1,IP
      STPOS=STPOS+(APOS-ZP(I))*(APOS-ZP(I))/(AP-1.0)
330  CONTINUE

```



```

      WRITE(6,400)STNEG
400  FORMAT(16X,'NEGITIVE VARIANCE',11X,'=',F7.2)
      WRITE(6,405)STPOS
405  FORMAT(16X,'POSITIVE VARIANCE',11X,'=',F7.2)
      STDP=SQRT(STPOS)
      STDN=SQRT(STNEG)
      WRITE(6,420)STDN
420  FORMAT(16X,'NEGITIVE STANDARD DEVIATION = ',F6.2)
      WRITE(6,425)STDP
425  FORMAT(16X,'POSITIVE STANDARD DEVIATION = ',F6.2)
500  FORMAT(1H1)
C    CALL PLOT SUBROUTINE
      CALL DRAW(NPTS,X,Y,MC,ITYPE,LABEL,TITLE,EXSC,YSCL,
1 IXUP,IYRT,MDXAX,MDYAX,IWIDE,IHIGH,IGRID,LAST)
C    COMPUTE PROBABILITIES
      YYY=0.0
      IJ=(NPTS/2)-1
      WRITE(6,9)
      WRITE(6,12)(TITLE(I),I=1,6)
      WRITE(6,12)(TITLE(I),I=7,12)
      WRITE(6,510)
510  FORMAT(////,18X,'PEAK TO PEAK POWER',10X,
1 'PROBABILITY VARIATION WILL')
      WRITE(6,520)
520  FORMAT(18X,'(ABSOLUTE VALUE, DB)',8X,
1 'BE LESS THAN GIVEN AMMOUNT',///)
      DO 600 I=1,IJ
      IJJ=NPTS-I+1
      YYY=YYY+Y(I)+Y(IJJ)
      PB(I)=(AA-YYY)/AA
      X(I)=X(IJJ)-DELTA
      WRITE(6,560)X(I),PB(I)
560  FORMAT(20X,F10.2,22X,F10.3)
600  CONTINUE
1000 CONTINUE
      STOP
      END

```



```

C      THIS PROGRAM ANALIZES SIGNAL STRENGTH PEAKS
C
C      PEAKS IN SIGNAL STRENGTH ARE INPUT AND THE PROGRAM
C      FIRST AVERAGES THEM, THEN IT NORMALIZES THE VALUES
C      BY SUBTRACTING THE AVERAGE FROM EVERY VALUE.
C      THE PROGRAM THEN COMPUTES AND PLOTS THE DISTRIBUTION
C      OF THE NORMALIZED VALUES ABOUT THE AVERAGE.
      DIMENSION X(900),Y(900),Z(900),ZN(900),ZP(900)
      REAL LABEL/ ' ' /
      REAL*8 TITLE(12)
5      READ(5,6)NOPLJT
6      FORMAT(13)
      READ(5,7)DELTA
7      FORMAT(F10.4)
      READ(5,8)(TITLE(I),I=1,2)
8      FORMAT(2A8)
      DO 1000 J=1,NOPLOT
C      INITIALIZE PARAMETERS FOR CALCOMP PLOT
      IWIDE=6
      IHIGH=7
      IGRID=1
      ITYPE=0
      MC=0
      IXUP=0
      IYRT=3
      MDXAX=2
      MDYAX=2
      EXSC=0
      YSCL=0
      WRITE(6,9)
9      FORMAT(1H1,////)
      READ(5,10)(TITLE(I),I=3,6)
10     FORMAT(4A8)
      READ(5,11)(TITLE(I),I=7,12)
11     FORMAT(6A8)
      WRITE(6,12)(TITLE(I),I=1,6)
      WRITE(6,12)(TITLE(I),I=7,12)
12     FORMAT(27X,6A8)
      WRITE(6,13)
13     FORMAT(//,38X,' DATA POINTS',/)
15     AVE=0.0
      READ(5,6)NPTSS
      AI=0.0
      READ(5,20)(Z(I),I=1,NPTSS)
20     FORMAT(F8.3)
C      COMPUTE AVERAGE AND STANDARD DEVIATION
      DO 100 I=1,NPTSS
      AI=AI+1.0
      AVE=AVE-(AVE-Z(I))/AI
100    CONTINUE
      IF(NPTSS.LT.586) GO TO 106
      WRITE(6,105)(Z(I),I=1,585)
      WRITE(6,9)
      WRITE(6,12)(TITLE(I),I=1,6)
      WRITE(6,12)(TITLE(I),I=7,12)
      WRITE(6,13)
      WRITE(6,105)(Z(I),I=586,NPTSS)
      GO TO 107
106    WRITE(6,105)(Z(I),I=1,NPTSS)
105    FORMAT(11X,9F7.1)
107    ST1=0.0
      DO 108 I=1,NPTSS
      ST1=ST1+(AVE-Z(I))*(AVE-Z(I))/(AI-1.0)
108    CONTINUE
C      NORMALIZE DATA
C      FIND MAXIMUM VALUE
      IN=0
      IP=0
      ZM=0.0

```



```

DO 130 I=1,NPTSS
Z(I)=Z(I)-AVE
IF(Z(I)) 110,130,120
110 IN=IN+1
ZN(IN)=Z(I)
IF(ZN(IN)+ZM) 125,130,130
120 IP=IP+1
ZP(IP)=Z(I)
IF(ZP(IP)-ZM) 130,130,125
125 ZM=SQRT(Z(I)*Z(I))
130 CONTINUE
ZZ=0.0
131 IF(ZM-ZZ) 134,134,132
132 ZZ=ZZ+1.0
GO TO 131
134 ZM=ZZ+DELTA
C COUNT NUMBER OF POINTS IN EACH TWO DELTA INTERVAL
AI=0.0
I=0
140 I=I+1
X(I)=AI-ZM
XL=X(I)-DELTA
XM=X(I)+DELTA
Y(I)=0.0
DO 150 K=1,NPTSS
IF(XL.GT.Z(K).OR.Z(K).GE.XM) GO TO 150
Y(I)=Y(I)+1.0
150 CONTINUE
AI=AI+DELTA*2.0
IF(ZM-X(I)) 160,160,140
160 NPTS=I
WRITE(6,180) AVE,ST1
180 FORMAT(/,16X,'AVERAGE POWER = 'F5.1,'DB',5X,
1'STANDARD DEVIATION = ',F5.1)
WRITE(6,190)
190 FORMAT(/,16X,'GRAPHED DATA IS, NORMALIZED POWER',
1' VS. POINTS AT THAT POWER',/)
WRITE(6,195)
195 FORMAT(16X,'NORMALIZED POWER, DB',13X,
1'POINTS AT THAT POWER',/)
C DO 230 I=1,NPTS
PRINT DISTRIBUTION
WRITE(6,200) X(I),Y(I)
200 FORMAT(20X,F10.2,20X,F10.1)
230 CONTINUE
C COMPUTE AVERAGE, VARIANCE, AND STANDARD DEVIATION FOR
C BOTH POSITIVE AND NEGATIVE DISTRIBUTIONS
AP=0.0
AN=0.0
APOS=0.0
ANEG=0.0
DO 240 I=1,IN
AN=AN+1.0
ANEG=ANEG-(ANEG-ZN(I))/AN
240 CONTINUE
DO 260 I=1,IP
AP=AP+1.0
APOS=APOS-(APOS-ZP(I))/AP
260 CONTINUE
WRITE(6,270) ANEG
270 FORMAT(/,16X,'NEGATIVE VALUES MEAN',8X,'=',F7.2)
WRITE(6,275) APOS
275 FORMAT(16X,'POSITIVE VALUES MEAN',8X,'=',F7.2)
STNEG=0.0
STPOS=0.0
DO 325 I=1,IN
STNEG=STNEG+(ANEG-ZN(I))*(ANEG-ZN(I))/(AN-1.0)
325 CONTINUE
DO 330 I=1,IP
STPOS=STPOS+(APOS-ZP(I))*(APOS-ZP(I))/(AP-1.0)
330 CONTINUE
WRITE(6,400) STNEG

```



```

400  FORMAT(16X,'NEGITIVE VARIANCE',11X,'=',F7.2)
      WRITE(6,405)STPOS
405  FORMAT(16X,'POSITIVE VARIANCE',11X,'=',F7.2)
      STDP=SQRT(STPOS)
      STDN=SQRT(STNEG)
      WRITE(6,420)STDN
420  FORMAT(16X,'NEGITIVE STANDARD DEVIATION = ',F6.2)
      WRITE(6,425)STDP
425  FORMAT(16X,'POSITIVE STANDARD DEVIATION = ',F6.2)
995  FORMAT(1H1)
C    CALL PLOT SUBROUTINE
      CALL DRAW(NPTS,X,Y,MC,ITYPE,LABEL,TITLE,EXSC,YSCL,
1    IXUP,IYRT,MDXAX,MDYAX,IWIDE,IHIGH,IGRID,LAST)
1000 CONTINUE
      STOP
      END

```


LIST OF REFERENCES

1. Barrick, D. E., "First Order Theory and Analysis of MF/HF/VHF Scatter from the Sea," IEEE Transactions of Antennas and Propagation, v. 20, no. 1, pp. 2-9, January 1972.
2. Beckman, P., and Spizzichino, A., The Scattering of Electromagnetic Waves from Rough Surfaces, MacMillan & Company, 1963.
3. ESSA Technical Report ESSA-ERL-104-ITS-74, Power Gains for Antennas Over Lossy Plane Ground, by M.T. Ma and L. C. Walters, April 1969.
4. ESSA Technical Report ESSA-ERL-110-ITS-78, Predicting Long-Term Operational Parameters of High-Frequency Sky-Wave Telecommunication Systems, by A. F. Barghausen, J. W. Finney, L. L. Proctor, and L. D. Schultz, May 1969.
5. Jordan, E. G., Electromagnetic Waves and Radiating Systems, Prentice-Hall, 1950.
6. Jansik, H., Antenna Engineering, McGraw-Hill, 1961.
7. Kraus, J. D., Antennas, McGraw-Hill, 1950.

INITIAL DISTRIBUTION LIST

	No. Copies
1. Defense Documentation Center Cameron Station Alexandria, Virginia 22314	2
2. Library, Code 0212 Naval Postgraduate School Monterey, California 93940	2
3. Asst. Professor J. B. Knorr, Code 52Ko Department of Electrical Engineering Naval Postgraduate School Monterey, California 93940	1
4. R. Goodbody, Code 2120 Naval Electronics Laboratory Center 271 Cataline Blvd. San Diego, California 92152	1
5. Professor R. W. Adler, Code 52Ab Department of Electrical Engineering Naval Postgraduate School Monterey, California 93940	1
6. ENS Stanley R. Szemborski, USN 937 North Camino Alto Vallejo, California 94590	1

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Naval Postgraduate School Monterey, California 93940		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE THE EFFECT OF ROLL AND PITCH ON ANTENNA RADIATION PATTERNS			
4. DESCRIPTIVE NOTES (Type of report and, inclusive dates) Master's Thesis; September 1972			
5. AUTHOR(S) (First name, middle initial, last name) Stanley Robert Szemborski; Ensign, United States Navy			
6. REPORT DATE September 1972		7a. TOTAL NO. OF PAGES 191	7b. NO. OF REFS 6
8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S)	
b. PROJECT NO.			
c.		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Naval Postgraduate School Monterey, California 93940	
13. ABSTRACT The strength of an incoming signal to a shipboard communications station is measured. The variations in this signal are analyzed for various conditions of roll, pitch, and signal direction. Graphs and computer outputs are used to present the magnitude and randomness of these signal variations. A smooth surface approximation is used to simulate the problem, and this simulation is compared to observed data.			

14	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
	SEA SCATTER ANTENNA RADIATION PATTERNS						

Thesis

070

Thesis
S98
c.1

139070

Szemborski

The effect of roll and
pitch on antenna radia-
tion patterns.

16 FEB 79
27 JUL 81
22 DEC 82

25031
26843
29006

Thesis
S98
c.1

Szemborski

139070

The effect of roll and
pitch on antenna radia-
tion patterns.

thesS98

The effect of roll and pitch on antenna



3 2768 001 01266 9

DUDLEY KNOX LIBRARY